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MACROECONOMIC POLICIES TO REDUCE THE CURRENT-ACCOUNT DEFICIT: TECHNICAL BACKGROUND

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PREFACE

This paper was prepared by Stephan Thurman, Nicholas Dugan, and Patricia Phill of the Fiscal Analysis Division. It was undertaken as technical background work to support the Congressional Budget Office study *Policies to Reduce the Current-Account Deficit* as requested by the Committee on Budget, U.S. House of Representatives. The views expressed in this paper are the authors' and do not necessarily reflect those of the Congressional Budget Office or other members of the staff.

The authors wish to thank Richard Haas, Paul Masson, and Steven Symansky of the International Monetary Fund for advice and suggestions provided on interpreting the IMF MINIMOD model. Further valuable assistance was provided by William Helkie, Peter Hooper, and Jaime Marquez of the Federal Reserve Board. At CBO, members of the Fiscal Analysis Division contributed comments and suggestions at various stages of model preparation and document drafting. Particularly appreciated was the assistance provided in this regard by Debra Blagburn, Mark Decker, Jeanne Dennis, Robert Dennis, Tilman Ehrbeck, Victoria Farrell, George Iden, Frederick Ribe, and Frank Russek. Thomas Lutton and Elizabeth Pinkston of CBO's Natural Resources Division reviewed the final draft, which was edited by Francis Pierce.

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INTRODUCTION

With the sharp increase in the U.S. current-account deficit during the 1980s, the relative effectiveness of alternative policies to reduce that deficit has come to the fore in public policy discussions. Policymakers and analysts are discussing actively whether to go about reducing the deficit through trade policy measures, closer international coordination of monetary and fiscal policies, or some combination of these measures. This paper and an accompanying Congressional Budget Office study add quantitative estimates to this discussion by reporting simulations of several alternative policy measures using an international econometric model.[1] The purpose of this paper is to provide technical background on the model and its properties. The main policy simulations and their interpretation are described in the other study.

This paper is organized as follows. Section II describes the econometric model used for these studies. The details of the model structure are presented in an appendix. Section III presents simulation experiments conducted with the model to examine the model's properties.

1. See Congressional Budget Office, *Policies to Reduce the Current-Account Deficit* (August 1989).

SECTION II

A DESCRIPTION OF THE SIMULATION MODELS USED

The model used for simulation analysis in this study differs from more familiar econometric models used by CBO in previous analyses in that it represents the economies of the rest of the world in addition to the U.S. economy. CBO has used a "world" model for this study because of the focus on the current-account balance of payments between this country and the rest of the world. Some of the topics that are discussed here, such as the importance of policy coordination between the United States and the rest of the world, would be impossible to analyze without the use of such a model. A world model also makes the analysis of other topics more thorough than would be the case with models that represent only the United States.

As a rule, CBO uses more than one econometric model in its analyses of policy actions in order to reflect a wide range of views. It was not practicable to do so in this study because world econometric models tend to be cumbersome, and most are not commercially available. Instead, previously published model-based simulation results were used to guide CBO in constructing a simulation model.[2]

Since the published results inevitably do not address all of the questions explored in this study, it was necessary to develop a single model for simulation analysis. The model was based on MINIMOD, a world model developed by Richard Haas and Paul Masson at the International Monetary Fund, but incorporating modifications described below.[3] In what follows, the general structure of MINIMOD is described first, and then descriptions are offered of the modifications CBO made in it.

BASIC CHARACTERISTICS OF THE ADAPTED MINIMOD MODEL

MINIMOD is a two-sector model of the United States and the rest of the world (hereafter, the ROW). The model's U.S. and ROW sectors are based on simulation results from the Federal Reserve Board's Multi-Country Model's U.S. and four non-U.S. sectors.[4] The model's ROW sector actually represents only four countries

2. These results generally provide a wide range of possible outcomes. See, for example, Robert King and Helena Tang, *International Macroeconomic Adjustment, 1987-1992: A World Model Approach*, World Bank Working Papers (November 1988).

3. See Richard Haas and Paul Masson,"MINIMOD: Specification and Simulation Results," *Staff Papers* (Washington, D.C.: International Monetary Fund), vol. 33 (1986), pp. 722-767.

4. The Multi-Country Model (MCM) was developed by economists in the Division of International Finance of the Federal Reserve Board for international economic research by the staff. Analysis and conclusions based on the use of the MCM represent the views of the MCM authors and should not be interpreted as reflecting those of the Board of Governors of the Federal Reserve System or members of its staff. See Guy Stevens, Richard Berner, Peter Clark, Ernesto Hernandez-Cata, Howard Howe, and Sung Kwack, *The U.S. Economy in an Interdependent World*

outside the United States. These countries, henceforth referred to as the MINIMOD4, are Canada, West Germany, Japan, and the United Kingdom. Economic outcomes in the United States and the ROW are determined simultaneously. While the original version of the model was able to simulate forward-looking, and hence computationally difficult, "rational" or "consistent" economic expectations, the version as specified for this study is a less complex adaptive expectations model.

The Structure of MINIMOD

Table 1 shows the theoretical equations of the modified MINIMOD used for this study. In the main, the structure follows that found in the original Haas-Masson model.[5] Most of the readily apparent differences from the original model are the result of different normalizations of the equations (that is, the ordering of the given equation for the variable the computer is asked to solve). This technical change was made necessary by CBO's computer software, which differed from that used in the original model. A second major departure from the Haas and Masson model is that CBO substituted equations from its own model of the U.S. current account, known as SLUSIT, in place of the corresponding MINIMOD equations for United States imports and exports.[6] Several other more minor changes were made in certain MINIMOD equations as explained below.

The Basic Model. The model's two sectors--the United States and the ROW--have the same basic structure. Both are primarily demand driven and are linked by markets for goods and financial services. Expectations in the CBO version of the model are adaptive, and are specified in the form:

$$B^e_t = \gamma B_t + (1-\gamma) B^e_{t-1}$$

where γ is the adaptive speed of adjustment of the expected value of any variable B^e with respect to its observed level B. Such expectations are formed for exchange rates, inflation, and long-term interest rates.[7]

In Table 1, domestic absorption (equations 1 and 17) consists of government purchases (which are exogenous), and endogenously determined consumption and investment. Consumption (equations 3 and 19) depends on wealth and disposable income, with an additional term (in the U.S. sector) involving the real long-term

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(Washington, D.C.: Board of Governors of the Federal Reserve System, 1984), and Hali Edison, Jaime Marquez, and Ralph Tryon, "The Structure and Properties of the FRB Multicountry Model," International Finance Discussion Paper #293 (Washington, D.C.: Board of Governors of the Federal Reserve System, 1986).

5. Haas-Masson, "MINIMOD" (1986), pp. 724-727.

6. Congressional Budget Office, "SLUSIT: Simple Little U.S. International Transactions Model" (processed, 1987).

7. The value of γ is a scalar bounded $0 \leq \gamma \leq 1$ which may change for different equations depending on the speed of adjustment. As γ approaches the value of 1, the speed of adjustment increases.

TABLE 1. EQUATIONS OF THE ADAPTED VERSION OF MINIMOD

U.S. Sector

1. Real domestic absorption

$$a = c + inv + g$$

2. Real domestic GDP

$$y = a + X - M$$

3. Real consumption

$$c = f (w, yd, rl - \bar{\pi})$$

where

$$w = \lambda_m \cdot m/p + \lambda_b \cdot b/p + f/p + k$$

and

$$yd = y \cdot p_q/p - \delta \cdot k - t/p + (r - \pi) \cdot (b + f)/p - (1 - \lambda_b) \cdot \Delta b/p$$

4. Real net investment

$$inv = (k - k_{-1}) - \delta \cdot k_{-1}$$

where

$$(k - k_{-1}) = f (\eta (\beta \cdot y/cc - k) + n \cdot k)$$

and

$$cc = \alpha \cdot (rl - \bar{\pi} + \delta) / (1 - \xi)$$

5. Government budget constraint

$$(b - b_{-1}) + (m - m_{-1}) = p \cdot g - t + r \cdot b_{-1}$$

6. Nominal tax receipts

$$t = f (p_q \cdot y - \delta \cdot p \cdot k + r \cdot (b + f))$$

7. Capacity output

$$y^c = A \cdot e^{(1-\beta)n\tau} \cdot k^{\beta}$$

8. GNP

$$q = y + r \cdot f/p_q$$

9. Domestic absorption deflator

$$p = ((y-X)/a) \cdot p_q + (M/a) \cdot p_M$$

10. Inflation rate

$$\Delta p_q/p_q = \pi^e + \phi(y/y^c)$$

11. Short-term interest rate normalized from money demand function

$$r = f (m_1/p, q)$$

where

$$m_1 = \mu \cdot m$$

12. Long-term interest rate

$$rl = rl^e \cdot ((1+r)/(1+rl^e))^{.25}$$

13. Exports of goods and nonfactor services

$$X = X_{na} + X_a + X_{so}$$ [From SLUSIT Current Account Model]

14. Imports of goods and nonfactor services

$$M = M_{np} + M_p + M_{so}$$ [From SLUSIT Current Account Model]

15. Open parity condition

$$\Delta(e^e)/e = (r + risk) - r^*$$

16. Accumulation of net claims on foreigners

$$f = F_{-1} + V(F_{-1}) + CA\$$$ [From SLUSIT Current Account Model]

ROW Sector

17. Real domestic absorption

$$a^* = c^* + inv^* + g^*$$

18. Real domestic GDP

$$y^* = a^* + X^* - M^*$$

19. Real consumption

$$c^* = f(w^*, yd^*)$$

where

$$w^* = \lambda^*_m \cdot m^*/p^* + \lambda^*_b \cdot b^*/p^* + f^*/p^* + k^*$$

and

$$yd^* = y^* \cdot p_q \cdot /p^* - \delta^* \cdot k^* - t^*/p^* + \theta\,(r^* - \pi^*) \cdot (b^* + f^*)/p^* - (1 - \lambda^*_b) \cdot b^*/p^*$$

20. Real net investment

$$inv^* = (k^* - k_{-1} \cdot) - \delta^* \cdot k^*_{-1}$$

where

$$(k^* - k^*_{-1}) = f(\eta \cdot (\beta^* \cdot y^*/cc^* - k^*) + n^* \cdot k^*)$$

and

$$cc^* = \alpha^* \cdot (rl^* - \pi^* + \delta^*) / (1 - \xi^*)$$

21. Government budget constraint

$$(b^* - b^*_{-1}) + (m^* - m^*_{-1}) = p^* \cdot g^* - t^* + r^* \cdot b^*_{-1}$$

22. Nominal tax receipts

$$t^* = f(p_q^* \cdot y^* - \delta^* \cdot p^* \cdot k^* + r^* \cdot (b^* + f^*))$$

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23. Capacity output

$$y^{c^*} = A \cdot e^{(1-\beta^*)n^*\tau^*} \cdot k^{\beta^*}$$

24. GNP

$$q^* = y^* + r^* \cdot f^* / p^*_q$$

25. Domestic absorption deflator

$$p^* = ((y^* - x^*)/a^*) \cdot p^*_q + (M^*/a^*) \cdot (p_q/e)$$

26. Inflation rate

$$\Delta p_q^*/p_{q\bullet} = \pi^{e^*} + \phi^*(y^*/y^{c^*})$$

27. Short-term interest rate normalized from money demand function

$$r^* = f(m^*_1/p^*, q^*)$$

where

$$m^*_1 = \mu^* \cdot m^*$$

28. Long-term interest rate

$$rl^* = rl^{e^*} \cdot ((1+r^*)/(1+rl^{e^*}))^{.25}$$

29. Exports of goods and nonfactor services

$$X^* = \text{TSCALE}(M)$$

30. Imports of goods and nonfactor services

$$M^* = \text{TSCALE}(X)$$

31. Accumulation of net claims by ROW

$$f^* = \text{TSCALE}(f)$$

Model Variable Definitions and Notation

a	Real domestic absorption
b	Nominal stock of government debt
c	Real domestic consumption
CA$	Nominal current account [SLUSIT Current Account Model]
cc	Real cost of capital
e	The effective exchange rate index (foreign currency price of the U.S. dollar)
f	Nominal stock of net claims on foreigners (denominated in dollars)
F	Net international investment position [The SLUSIT Current Account model form of f]
g	Real general government expenditures
inv	Real domestic investment
k	Capital stock
M	Real imports of goods and nonfactor services [SLUSIT Current Account Model]
M_{np}	Real nonpetroleum imports [SLUSIT Current Account Model]
M_p	Real petroleum imports [SLUSIT Current Account Model]
M_{so}	Real other service imports [SLUSIT Current Account Model]
m	Nominal money base
m_1	Nominal money supply
n	The sum of rates of growth of the labor force and labor productivity; that is, the economy's steady-state growth rate.
p	Absorption deflator

p_M	Implicit import deflator [SLUSIT Current Account Model]
p_q	Implicit GNP deflator
q	Real GNP
r	Short-term interest rate
risk	Risk premium (discount) on dollar denominated assets, by assumption
rl	Long-term interest rate
rl^e	Expected long-term interest rate
t	Nominal tax receipts
w	Real wealth
X	Real exports of goods and nonfactor services
X_a	Real agricultural exports [SLUSIT Current Account Model]
X_{na}	Real nonagricultural exports [SLUSIT Current Acct. Model]
X_{so}	Real other service exports [SLUSIT Current Account Model]
y	Real GDP
y^c	Real capacity GDP output
yd	Real disposable income
α	Cost of capital scale parameter to drive capital stock toward the long-term desired capital stock
β	The relative stock of capital in output
Δ	First difference operator, i.e., $\Delta x = x - x_{-1}$
δ	Rate of depreciation of lagged capital stock
η	Speed of adjustment of capital stock to its desired level
λ_b	Proportion of government debt considered wealth
λ_m	Proportion of money base considered wealth
μ	Money multiplier

ξ	Marginal tax rate
π	Inflation rate
π^e	Expected inflation rate
τ	Time
f(−)	Behavioral equation functional form
V(−)	Valuation operator
*	Foreign MINIMOD4 variable
$	Current dollar notation

interest rate. Wealth consists of the physical capital stock, less net borrowing from foreigners, plus a proportion of government bonds and money. Disposable income consists of nominal net national product less taxes, plus the interest on net holdings of financial assets (government bonds less debt to foreigners). Investment (equations 4 and 20) is modeled so as to move the capital stock toward a desired capital stock that depends on output and the user cost of capital, with elasticities of 1 and -1 respectively.

The goods and services that constitute absorption in the model come both from domestic production and from net imports. Import and export volumes are driven by relative U.S. and foreign prices and by income levels. Domestic production at full capacity is determined by a Cobb-Douglas production function (equations 7 and 23) in capital, which is determined endogenously on the basis of past levels of investment and labor. The labor market is implicit in the model. Labor input into the production process is represented by a simple time trend. Actual production, which is demand driven, can differ from full-capacity production, so the capacity utilization rate varies.

The dynamics of domestic prices are determined by inflation expectations and by capacity utilization. The inflation model is accelerationist, since in the reduced form the sum of the coefficients on past inflation is unity. Inflation expectations are driven by the adaptive process described above, applied to the absorption deflator. Prices of domestic production (equations 10 and 26) increase at the rate of inflation, but depend also on capacity utilization. Because inflation expectations depend on the absorption deflator, the model guarantees that factors (such as import prices) that affect the absorption deflator will eventually also influence the prices of domestically produced goods. The absorption deflator (equations 9 and 25) depends on prices of domestic production and on import prices. The treatment of prices can alternatively be understood as a process of adjustment of nominal wages (which are implicit in the model) to past absorption prices (standing for consumer prices), together with a markup model for prices of domestic production.

The short-term interest rate (equations 11 and 27) is determined by an inverted money demand function and by an exogenous money supply. Long rates (equations 12 and 28) come from a term-structure formulation in which long rates adjust after one quarter to an expected long rate. The expected long rate is adaptively formed from past long rates, again using the process illustrated above.[8] The exchange rate is determined in an open parity condition (equation 15) that sets the expected change in the exchange rate equal to the short-term interest rate differential between the United States and the rest of the world.

Changes Made by CBO in the Basic MINIMOD Specification

The model used by CBO differs in two major respects from the original model developed by Haas and Masson. First, the portions of MINIMOD that describe the formation of import and export prices and volumes, and the accumulation of net

8. The value of γ in the adaptive expectations equations for U.S. and rest-of-world expected long rates is 0.2, indicating a very slow speed of adjustment of actual long rate realizations of movements in short rates.

claims on foreigners, were replaced by the equations of CBO's SLUSIT current account model. Second, other changes were made in the model structure to bring the model's behavior closer to simulation analyses performed in previous CBO studies.

The SLUSIT Equations. By far the major change from the original MINIMOD structure is the substitution of the more detailed CBO SLUSIT current-account model for MINIMOD's aggregate equations for nonfactor exports and imports of goods and services, and for the external net accumulation of claims on foreigners.

Some 16 SLUSIT behavioral equations and 150 SLUSIT identities replace the approximations found in the MINIMOD equations for U.S. exports (equation 13) and imports (equation 14) and their corresponding prices, and for the U.S. net international investment position (equation 16). The foreign counterparts to these trade and income flows (equations 29, 30, and 31) are based on the U.S. flows, scaled appropriately to reflect the fact that the MINIMOD ROW sector covers explicitly only a subset of all the countries with which the United States trades. SLUSIT import prices also replace the approximation used in the MINIMOD absorption deflator equations (equations 9 and 25). A brief description of the SLUSIT model is presented in the next section.

The substitution of SLUSIT for MINIMOD equations was intended to incorporate three important properties of the more detailed current account model that were absent in MINIMOD:

- The adapted model treats the responses of import and export prices to exchange rate changes in a way that corresponds more closely to recent experience. The passthrough of exchange rate changes to U.S. import prices, which is assumed to be full and immediate in MINIMOD, is substantially less than full in the SLUSIT equations and takes about eight quarters to reach its peak. On the other hand, the foreign currency equivalents of U.S. export prices move immediately and fully with exchange rate changes in SLUSIT, as they do in MINIMOD. There is support in the literature for this lack of symmetry in response, especially as regards the more recent behavior of import prices following exchange rate appreciation and depreciation.[9]

- As a result of its slower passthrough of exchange rate changes, SLUSIT has a less pronounced J-curve than the original MINIMOD. A dollar depreciation-induced change in import prices initially causes the nominal net export balance to deteriorate in MINIMOD before export and import

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9. See, for example Rudiger Dornbush "Exchange Rates and Prices" National Bureau of Economic Research Working Paper No. 1769 (December 1985) and Catherine Mann, "Prices, Profit Margins, and Exchange Rates," *Federal Reserve Bulletin* (June 1986). Both argue that changes in foreign profit margin absorption have diminished the passthrough of exchange rates to import prices. Sequential sample period estimates by Stephan Thurman, "Up and Down the Exchange Rate-Price Inflation Ladder," Congressional Budget Office (processed, 1986), suggest this to be a temporary phenomenon. In a more recent study, Peter Hooper and Catherine Mann suggest the asymmetric response of export and import prices will remain. See "Exchange Rate Pass Through in the 1980s: The Case of U.S. Imports of Manufactures," Brookings Panel on Economic Activity (April 1989).

volumes respond to yield an improved balance. In SLUSIT, on the other hand, there is a much smaller and shorter-lived J-Curve for nonagricultural and nonoil trade, as a result of the delayed and less than full passthrough of changes in the exchange rate into prices of traded goods.[10]

- The SLUSIT coefficients showing the responses of U.S. imports to U.S. GNP differ from those in the original MINIMOD. The long-run elasticity of U.S. imports to the scale variable (U.S. absorption) in MINIMOD is very high by the standards of recent independent estimates--2.3. The corresponding elasticity in the SLUSIT model to its scale variable (U.S. GNP) is much lower, at 1.2.[11] For total nonservice-factor income imports, the aggregate elasticity is 1.2, while for the corresponding export income elasticity, the aggregate value is near unity in both models. The Houthakker-Magee proposition--whereby the income elasticity differential implies that equal activity growth in the U.S. and in the ROW will result in net deterioration in U.S. external balances--is satisfied in both versions of the model.[12]

An additional reason for incorporating the more detailed SLUSIT treatment of the U.S. current account into MINIMOD is that SLUSIT offers increased analytical detail. Some economic variables that can only be approximated in MINIMOD are made explicit in the linked MINIMOD-SLUSIT model. In the Haas-Masson equation for net claims on foreigners (the original model's equation 16), for example, a r*f flow term represents an approximation to net service factor income receipts less payments with a single interest rate times a lagged stock variable. In the SLUSIT model, by contrast, receipts and payments of service factor income are treated as separate functions of their own implicit interest rates and lagged asset and liability stocks, all of which may move in different directions.

A final advantage of incorporating the SLUSIT model is that, unlike MINIMOD, it represents both the national income and product accounts (NIPA) and balance of payments accounts (BOP) versions of the U.S. external balance. There are definitional differences between these measures that have important implications for the U.S. external debt position. These are mostly attributable to net unilateral transfers and net government interest payments abroad, which are included in the current account balance that is included in BOP figures, but not in the NIPA version (see SLUSIT equations 12 and 13, Table 3). Since the current

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10. For a discussion of the varying nature of the strength of the J-curve phenomena, see Stephan Thurman and Lucia Foster, "The Effects of Prolonged Exchange Rate Episodes on Trade Equation Parameters," Congressional Budget Office (processed, 1986).

11. See Peter Hooper, "Discussion," *Brookings Papers on Economic Activity* (Washington, D.C.: Brookings Institution, 1987), vol. 1, pp. 47-51, for a discussion of possible bias in estimated import demand functions that exclude relative U.S.-to-foreign capacity variables. Inclusion of these concepts yields estimated income elasticities more in line with the magnitude reported for the SLUSIT model, as evidenced in the comparisons in Table 5 below.

12. The Marshall-Lerner condition, which holds that the absolute value-sum of the two aggregate price elasticities must exceed unity for an exchange rate depreciation to improve the external balance, is also satisfied in both models see Table 4 below.

account determines the U.S. external debt position, the merging of SLUSIT captures this effect, whereas the single NIPA concept approximated in MINIMOD cannot.

Other MINIMOD Model Changes. Early simulations of the original MINIMOD as constructed by CBO turned up a number of model traits that were subsequently modified to make the model's properties correspond more closely to desired theoretical properties or to previous model simulation analyses performed by CBO.[13]

The most significant modification was occasioned by the fact that the original model incorporated non-neutrality of money. Neutrality of money is a principle, widely accepted among economists, implying that changes in the money supply have permanent effects only on prices--not on real economic variables. In the original MINIMOD, by contrast, monetary stimulus would greatly increase investment and full-capacity output--important real variables--largely avoiding any long-run increase in prices. CBO addressed this problem through changes in the investment and consumption sectors of the model.

The investment equations in the original MINIMOD seem to overstate the response of investment to interest rate changes. The theory underlying the investment equations, as mentioned above, is that investment serves to adjust the capital stock toward a desired level, which is computed explicitly in the model. This assumption is not convincing, however, if the calculated desired capital stock differs substantially from the actual capital stock in the baseline simulations, as occurred in CBO's early simulations with the model. Such a discrepancy can occur either because the assumptions of the model do not conform well to the data, or because an important variable in the calculation of the desired capital stock, the "user cost of capital," is estimated imprecisely in the model. These problems were present in both the U.S. and ROW sectors of MINIMOD, but were more severe in the ROW sector.

Consequently, CBO scaled the desired capital stock equations in both the U.S. and ROW sectors to bring them closer to baseline projections of actual capital stocks. The effect was to reduce substantially the elasticity of investment to interest rate changes in the ROW sector and to increase somewhat the corresponding elasticity in the U.S. sector.

Consumption equations. Another property of the original MINIMOD that appeared to contribute to the observed nonneutrality of money in the ROW sector was that the original equations implied an initial reduction in ROW consumption when the ROW money supply was increased. The ROW consumption function (equation 19) depends on real wealth and real disposable income. Real disposable income includes a term for net interest income that is simply the real short-term interest rate multiplied by real net holdings of bonds and foreign-country debt. This formulation appears to imply that all debt has a maturity of less than a quarter, so that interest income is quite sensitive to changes in short-term rates. In the ROW sector, where the private sector is a large net creditor, the model predicts a substantial and immediate reduction of interest income when interest rates fall,

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13. CBO constructed the original version of MINIMOD from the IMF *Staff Papers* article and with assistance kindly provided by the IMF authors. Thus, the version as constructed by CBO may differ in properties from that simulated by the IMF staff. In what follows, no criticism of these authors, their work, or the original IMF MINIMOD model is intended.

which is large enough to produce an initial decline in consumption. As a result, a reduction in interest rates from monetary stimulus both increases investment and increases saving to finance this investment, so that the IS curve is very steep. In most other models, by contrast, the short-run IS curve is flatter and monetary stimulus produces a smaller interest rate decline and an increase in consumption.

To conform to this property, CBO changed the MINIMOD equation for ROW disposable income to reflect roughly the fact that average debt maturity is substantially greater than one quarter. In the first quarter of the simulations, real interest income was assumed not to change at all. By the end of the simulations' horizon of 10 years, however, all debt was assumed to have been turned over, so that interest income matched the product of interest rates and financial asset stocks. The effect of this change was to reduce the slope of the IS curve for the ROW sector. A similar change could theoretically be made in the U.S. sector of the model, but because the U.S. private sector is not so substantial a net creditor, it would make much less difference to the results.

More minor CBO changes to the original MINIMOD included the following:

- The MINIMOD equation for U.S. taxes implied a larger average marginal tax rate than seems to be consistent with current tax law. The implicit tax rate was adjusted to a CBO estimate.

- CBO made different assumptions than did the IMF staff regarding the proportion of government interest-bearing debt that is included in private wealth. The CBO version of the model assumed that 70 percent of government bonds enter private wealth, while the MINIMOD version apparently used a figure of 100 percent.

- An additional exogenous variable, interpreted as the risk premium or discount on holding dollar assets, was introduced into the exchange rate equation (equation 15). This variable was used in some simulations to introduce "autonomous" changes in exchange rates--rate movements that are unrelated to changes in policy variables.

Table 2 shows the combined model's single-equation derived elasticities. The elasticities in the traded sector are those from the SLUSIT model. Since several of the original MINIMOD equations are linear in levels, these equation elasticities were calculated from single-equation shocked simulations.[14] Full-model simulation properties are discussed in the next section.

14. These are calculations where the elasticity is derived from a simulation of each equation individually coded with all determining variables considered exogenous. The elasticity is simply the percentage change in the endogenous variable relative to a 1 percent change in each determining variable.

TABLE 2. ELASTICITIES OF PRINCIPAL VARIABLES IN THE CBO VERSION OF MINIMOD WITH RESPECT TO INCOME, PRICES, INTEREST, AND EXCHANGE RATES (Percent change in variable listed at left induced by 1 percent change in variable listed at top of column)

	U.S. Sector Variables					ROW Sector Variables					
	Income	Prices	Short-Term Interest Rate	Long-Term Interest Rate	Exchange Rate	Income	Prices	Short-Term Interest Rate	Long-Term Interest Rate	Domestic Wealth	Domestic Money Supply
U.S. Sector											
Consumption	0.97	-0.75		-0.68						0.16	
Investment	1.20			-7.5							
Government											
Exports		-0.63			0.66	1.04	0.66				
Imports	1.20	1.00			-0.71		-0.71				
Absorption prices	0.95		0.14		0.13		0.13				
Short-term interest rates	10.80	11.60									-11.60
Long-term interest rates			1.40								
Rest-of-World Sector											
Consumption						1.20	-1.00			0.10	
Investment						1.25			-11.7		
Government											
Exports	1.20	1.00			-0.71		-0.71				
Imports		-0.63			0.66	1.04	0.66				
Absorption prices		0.04	-0.06		-0.03	1.10					
Short-term interest rates						7.80	9.70				-9.70
Long-term interest rates								1.40			
Exchange Rate			-0.57					0.59			

SOURCE: CBO staff calculations.

NOTE: The figures indicate partial elasticities--that is, the direct effects of the variables listed at the top on the variables listed at the left, as predicted by the individual MINIMOD equations.

THE CBO CURRENT-ACCOUNT MODEL, SLUSIT

CBO's SLUSIT current-account model was designed for use in CBO projections and policy analysis.[15] The structure of the model is virtually unchanged since its initial estimation in 1984. The model follows the general structure of the MPS and USIT models maintained by the Federal Reserve Board staff.[16] The basic accounting system of the model is taken from NIPA accounts, though variables in the BOP and Census Bureau accounts are also consistently determined by the model. The model, in its partial equilibrium form, is divided into five recursive blocks: (I) trade volumes, (II) trade prices, (III) other services volume, (IV) service-factor-income, and (V) balances.

Exports are disaggregated into computer, agricultural, and nonagricultural categories and imports into computer, oil, and nonoil flows. Services are disaggregated by service-factor-income (sfi) export receipts and import payments, and by other (non-sfi, including travel, transportation, and miscellaneous) service exports and imports. Both computer trade volume and computer prices are exogenous in the model. Other non-service-factor-income trade volumes are endogenous. Service-factor-income export and import values are determined endogenously--volumes and prices are not modeled separately. The only prices that are determined endogenously are those for nonagricultural, noncomputer exports and nonoil, noncomputer imports. Other traded prices in the model are exogenous, or are driven by these two equations.

In the stand-alone or partial-equilibrium form of the SLUSIT model, domestic and foreign activity and prices, as well as interest rates and exchange rates, are exogenous. In the linked SLUSIT-MINIMOD system, by contrast, most of these variables are determined endogenously in MINIMOD. The basic structure and properties of the SLUSIT model are summarized in Tables 3-5. While the size of the SLUSIT current account model exceeds 150 equations, its basic structure may be represented by the 20 theoretical equations shown in Table 3. Table 4 shows SLUSIT model single-equation elasticities. For comparison purposes, current-account sector elasticities from other econometric models are shown in Table 5.

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15. See Congressional Budget Office, "SLUSIT: Simple Little U.S. International Transactions Model" (processed, 1988).

16. See Flint Brayton and Eileen Mauskopf, "The Federal Reserve Board Quarterly Econometric Model of the U.S. Economy," Board of Governors of the Federal Reserve System (1987), William L. Helkie, "A Forecasting Model for the U.S. Merchandise Trade Balance," Board of Governors of the Federal Reserve System (1985), and William L. Helkie and Peter Hooper, "The U.S. External Deficit in the 1980's: An Empirical Analysis," Board of Governors of the Federal Reserve System (1987).

TABLE 3. EQUATIONS OF THE SLUSIT CURRENT-ACCOUNT MODEL

I. Trade Volumes

1. Nonagricultural Export Volume

$$\underset{+}{X_{na}} = f\,(\underset{+}{Y^*}, \underset{-}{[L8](P_{xna}/E\,P^*)}, \underset{}{DS})$$

2. Agricultural Export Volume

$$\underset{+}{X_a} = f\,(\underset{+}{Y^*}, \underset{-}{[L5](P_{xa}/E\,P^*)}, \underset{-}{[L4](P/P_{xa})})$$

3. Nonpetroleum Import Volume

$$\underset{+}{M_{np}} = f\,(\underset{+}{Y}, \underset{-}{[L8](TR\,P_{mnp}/P)}, \underset{+}{[L5](SP)}, \underset{-}{CU^*/CU}, \underset{}{DS})$$

4. Petroleum Import Volume

$$\underset{+}{C_e} = f\,(\underset{+}{Y}, \underset{-}{[L32](TR\,P_e/P)}, \underset{}{DE})$$

$$M_p = K_p\,(C_e - S_e + \Delta I_e)$$

II. Prices

5. Nonagricultural Export Price

$$\underset{+}{P_{xna}} = f\,(\underset{+}{[L7](P)}, \underset{+}{(P^*/E)})$$

6. Nonpetroleum Import Price

$$P_{mnp} = f(P, [L6](P^*), [L6](E)) \quad (+, +, -)$$

III. Services

7. Other Services Export Volume

$$X_{so} = f(Y^*, [L6](P_{xso} E/P^*), TRADE) \quad (+, -, +)$$

8. Other Services Import Volume

$$M_{so} = f(Y, [L6](P_{mso}/P), TRADE) \quad (+, -, +)$$

IV. Service-factor-income

9. Service-factor-income Export Receipts

$$R_x = f(R, (P_{mp} E/P^*)) \quad (+, +)$$

$$X\$_{sfi} = R_x A$$

10. Service-factor-income Import Payments

$$R_m = f(R) \quad (+)$$

$$M\$_{sfi} = R_m A^*$$

V. Balances

11. Net Export Balance in 1982$

$$NetX = (X_{na} + X_{a} + X_{so} + X_{sfi}) - (M_{np} + M_{p} + M_{so} + M_{sfi})$$

12. Net Export Balance in Current Dollars

$$NetX\$ = (X\$_{na} + X\$_{a} + X\$_{so} + X\$_{sfi}) - (M\$_{np} + M\$_{p} + M\$_{so} + M\$_{sfi})$$

13. Current Account Balance in Current Dollars

$$CA\$ = (NetX\$)^{\#} - Y\$_{nut} - Y\$_{mg}$$

14. Net International Investment Position

$$F\$ = F\$.1 + V(F\$.1) + CA\$$$

Model Variable Definitions and Notation

A$	Balance of payments asset stocks
CA$	Balance of payments current account
C_e	Energy consumption in Btu's
CU	Capacity utilization
DE	Oil import embargo dummy
DS	Applicable dock strike dummy
E	Exchange rate index, foreign currency/dollar
F$	Net international investment position of the U.S.
ΔI_e	Change in inventory stocks of petroleum
K_p	Historical conversion ratio for Btu's to 1982 dollars
M_{np}	Nonpetroleum import volume in 1982$
M_p	Petroleum import volume in 1982$
M_{sfi}	Service-factor-income payments imports in 1982$
M_{so}	Other services import volume in 1982$
NetX	NIPA net exports of goods and services in 1982$
NetX$	NIPA net exports of goods and services in current dollars
P	U.S. price deflator
P^*	Foreign-weighted average CPI
P_{mnp}	Nonpetroleum import price deflator
P_{mp}	Petroleum import price deflator
P_{mso}	Other services import price deflator
P_{xa}	Agricultural export price deflator
P_{xna}	Nonagricultural export price deflator

P_{xso}	Other services export price deflator
R	U.S. Treasury bill interest rate
R_m	Implicit interest rate for M_{sfi}
R_x	Implicit interest rate for X_{sfi}
S_e	Domestic petroleum production
SP	Relative capital stock supply variable
TR	Average applicable tariff rate
TRADE	Trade value = $(X\$_{na} + X\$_a + M\$_{np} + M\$_p)$
X_a	Agricultural export volume in 1982$
X_{na}	Nonagricultural export volume in 1982$
X_{sfi}	Service-factor-income receipt exports in 1982$
X_{so}	Other services exports in 1982$
Y	Real U.S. GNP in 1982$
Y^*	Foreign weighted average real GNP/GDP

Notation

$	Current dollar value, obtained by $Px_i X_i$ or $P_{mi} M_i$
*	Weighted average foreign variable where weights may be different for different equations as described in the text
#	Indicating variables redefined to different accounting basis--i.e., NIPA basis variables adjusted to BOP basis
f(*)	Estimated behavioral equation functional form
V(*)	Valuation operator to adjust the value of former asset stocks or liabilities for changes in worth or exchange rates
[Ln]	Distributed lag operator for a lag of i=0,-1,-2,...,-n periods back in time
+,-	Notation above behavioral equation determinants indicating expected sign of coefficient

TABLE 4. ELASTICITIES OF EXPORTS AND IMPORTS IN THE SLUSIT CURRENT-ACCOUNT MODEL WITH RESPECT TO INCOME, PRICES, AND EXCHANGE RATES (Percentage change in variable listed at left induced by 1 percent change in variable listed at top of column)

	Income	Price	Exchange Rate
Exports			
Agricultural	.862	-.13	-.91
Nonagricultural[a]	1.114	-.80	-.72[b]
Other services	.89	-.39	-.35[b]
Aggregate[c]	1.035	-.632	-.66
Imports			
Petroleum	2.011[d]	-.74[d]	0.0[e]
Nonpetroleum[a]	1.160	-1.03	-.84[f]
Other services	.442	-1.17	-.96[f]
Aggregate[c]	1.204	-1.001	-.714

SOURCE: CBO staff calculations.

NOTE: The figures indicate "single-equation" elasticities: they reflect only direct effects of a variable listed at the top on a variable listed at the left, as predicted by the single equation that determines the variable listed at the left.

a. In June of 1988 the nonagricultural export and nonpetroleum import volume and price equations were expunged of trade in computers.

b. Export price equations include a competing markup price term for the exchange rate with an elasticity of -.1. Hence the final elasticity of export volume with respect to the exchange rate is (1-.1) of that with respect to own price.

c. The aggregate elasticities are derived from a weighted average of the sector elasticities using the average previous year's volume weight. Since the total exports and imports of nonservice-factor-income, noncomputer goods, and services represent about 75 percent of all net exports, the aggregate elasticities should not be interpreted as representing the responsiveness of the full current account model to imposed exogenous shocks.

d. Oil import volume is a derived residual equation from the total energy demand (bqet) equation. Since oil represents 46 percent of the defined total energy variable, the estimated income (.925) and price (-.34) elasticities for bqet are consequently scaled to be .925/.46 = 2.011 and -.34\.46 = -.74 for oil import demand.

e. Since oil imports are primarily dollar-denominated in world oil markets, they have a zero elasticity with respect to the exchange rate.

f. Import price equations pass only 82 percent of exchange rate changes through to final import prices. Hence, the final elasticity of import volume with respect to the exchange rate is .82 of that with respect to own price.

TABLE 5. ELASTICITIES OF PRICES AND VOLUMES OF TRADED GOODS WITH RESPECT TO THEIR MAJOR DETERMINANTS IN THE SLUSIT CURRENT-ACCOUNT MODEL AND IN OTHER PROMINENT ECONOMETRIC MODELS[a]

	Percentage Response of:					
	Nonagricultural Export Prices			Nonpetroleum Import Prices		
	To a 1 Percent Change in:					
Model	U.S. Price	Foreign Price	Exchange Rate	U.S. Price	Foreign Price	Exchange Rate
SLUSIT	1.02_0	0.15_4	0.15_4	0.06_0	0.80_0	0.80_8
DRI	–	–	0.17_8	–	–	0.84_6
EPA	–	–	0.20_0	–	–	0.50_0
MCM	—	—	0.23_3	—	—	0.91_7
GEM	—	—	0.00	—	—	0.25_0
OECD	—	—	0.60_4	—	—	0.90_0
TAYLOR	—	—	0.00	—	—	1.00_*
MPS	—	—	0.05_4	—	—	0.72_{10}
USIT	1.0_5	0.21_4	0.21_4	—	0.86_0	0.91_8

	Percentage Response of:			
	Nonagricultural Export Volumes		Nonpetroleum Import Volumes	
	To a 1 Percent Change In:			
Model	Foreign Income	Relative Prices	U.S. Income	Relative Prices
SLUSIT	1.03_0	-0.77_8	1.31_0	-1.03_8
DRI	1.00_3	-0.72_8	1.20_4	-1.10_5
EPA	1.20_0	-0.79_8	1.80_0	-1.00_4
MCM	2.10_0	-0.84_8	2.10_0	-1.20_7
GEM	1.00_0	-0.54_6	1.60_0	-1.20_8
OECD	1.00_0	-1.00_{10}	2.00_0	-0.80_{10}
TAYLOR	1.30_*	-0.63_*	2.50_*	-0.70_*
MPS	1.00_0	-0.68_{12}	1.04_0	-1.04_8
MINIMOD	0.76_*	-1.10_*	2.28_*	-0.57_*
USIT	2.19_0	-0.83_9	2.11_0	-1.15_8

SOURCES: CBO Staff calculations, Brayton and Mauskopf (1986) for MPS, Hooper and Helkie (1988) for USIT, and Ralph C. Bryant, Gerald Holthom, and Peter Hooper, *External Deficits and the Dollar: The Pit and the Pendulum*, The Brookings Institution, Washington, D.C. (1988), pp. 131-132 for the remaining models.

NOTE: Models referred to in table:

DRI: Data Resources, Inc.
EPA: Economic Planning Agency (Japan)
MCM: Multi-Country Model (Federal Reserve Board)
GEM: Global Economic Model (National Institute for Economic and Social Research, United Kingdom)
OECD: Organization for Economic Cooperation and Development
TAYLOR: Professor John Taylor (Stanford University)
MPS: Federal Reserve Board Quarterly Model
USIT: U.S. International Transactions (Federal Reserve Board)

a. Subscripts below elasticity values indicate length of estimated distributed lag. An asterisk indicates an infinite geometric lag structure estimated with a lagged dependent variable.

Several mechanical issues arose in the process of linking MINIMOD and SLUSIT because of differences in the base periods with respect to which certain variables were measured, and in the sets of countries covered in their respective "rest of world" sectors.

First, U.S. variables denominated in real dollars were stated in terms of 1972 dollars in MINIMOD, but in 1982 dollars in SLUSIT. This problem was solved by leaving the base years originally used for these series as they were, but equating the growth rates of equivalent variables in the two models. When simulation of MINIMOD implied a given growth rate for its 1972-based real U.S. GNP measure, for example, the linkage between the models made SLUSIT's 1982-based real GNP measure grow by that same percentage.[17]

A more complicated set of concerns arose because of differences in coverage of the models' rest-of-world sectors. In the stand-alone version of SLUSIT, variables representing prices, exchange rates, and levels of economic activity in all foreign countries are exogenous. The purpose of linking SLUSIT and MINIMOD is to permit MINIMOD to determine the behavior of some or all of these foreign economic variables endogenously. MINIMOD's foreign sector, however, uses data for the MINIMOD4 industrial countries (Japan, Canada, West Germany, and the United Kingdom) and treats this block as though it were the entire world outside the United States. In contrast, SLUSIT, incorporates variables aggregating economic activity, prices, and exchange rates for 18 foreign countries, hereafter referred to as the Federal Reserve Board 18 (FRB18). These 18 countries can usefully be broken down into the MINIMOD4, six other industrialized countries (FRB6), and a block of eight "newly industrializing" countries (NIC8).

In linking the two models together, CBO preserved the flexibility of having MINIMOD's foreign behavior (actually representing only the MINIMOD4) endogenously determine the behavior of variables for either the full FRB18 in SLUSIT or for one or both of the smaller groups of countries--either the MINIMOD4 only, or the group of all 10 industrialized countries. When CBO decided to use MINIMOD to determine only a subset of the 18 countries incorporated in SLUSIT, the behavior of the remaining countries was determined exogenously.

The various foreign economic variables are represented in SLUSIT through weighted averages of the values for the 18 individual FRB18 countries. The weights differ depending on the variable, as shown in Table 6. The form of the weighted average in the stand-alone SLUSIT model for a given economic variable, V, is geometric:

$$V = EXP(w_1*\log(V_1) + w_2*\log(V_2) + \ldots + w_{18}*\log(V_{18}))$$

17. An alternative would have been to rebase the MINIMOD data set to a 1982 base. This would have involved, however, recalculating many of MINIMOD's linear real equations. Rebasing would not only have been a time-consuming task,but might also have moved the model farther away from the original MINIMOD properties. After experimenting with this approach, the CBO staff decided that it would not significantly alter the results reported below.

TABLE 6. WEIGHTS USED IN COMBINING VALUES FOR DIFFERENT COUNTRIES IN WEIGHTED-AVERAGE EXCHANGE RATE, PRICE LEVEL, AND INCOME VARIABLES IN SLUSIT CURRENT-ACCOUNT MODEL

Country	Multi-lateral Trade Weights[a]	Bilateral Non-oil Import Weights[a]	Bilateral Nonagri-cultural Export Weights[b]
1. Canada	.056	.239	.239
2. West Germany	.147	.087	.048
3. Japan	.111	.194	.084
4. U.K.	.085	.055	.061
MINIMOD4	(.399)	(.575)	(.432)
5. France	.094	.039	.036
6. Italy	.068	.035	.022
7. Belgium	.051	.016	.028
8. Netherlands	.058	.014	.024
9. Switzerland	.025	.018	.017
10. Sweden	.024	.013	.009
FRB6	(.320)	(.135)	(.136)
11. Brazil	.043	.033	
12. Korea	.044	.043	
13. Malaysia	.023	.016	
14. Mexico	.031	.058	.062
15. Philippines	.013	.015	
16. Singapore	.043	.016	
17. Taiwan	.040	.066	
18. Hong Kong	.042	.043	
Non-Mexico NIC			.200
Other OECD			.077
OPEC			.093
NIC8	(.280)	(.290)	(.432)

SOURCE: CBO staff calculations and B. Dianne Pauls and William L. Helkie, "A Reassessment of Measures of the Dollars's Effective Exchange Value," International Finance Discussion Paper #306, Board of Governors of the Federal Reserve System (April 1987).

a. Used for weighted average foreign CPI prices and effective exchange rate indexes.

b. Used for weighted average foreign real GNP indexes.

where V is the weighted average for the FRB18, V_i is the value of that same variable for individual country i, w_i is the weight attached to that country, EXP is the exponentiation operator, and log is the logarithm operator. In the version of SLUSIT linked to MINIMOD, by contrast, the form of the expression is:

$$V = EXP(w4*\log(V4) + w6*\log(V6) + w8*\log(V8))$$

where V4, V6, and V8 represent variables for the MINIMOD4, the other FRB6 industrialized countries, and the NIC8 countries, respectively.

One final important observation should be made concerning the linkage of the two models. The prepared database for the original MINIMOD model that was available to CBO contained data on actual economic conditions only up through 1986. In addition, while values for the exogenous and endogenous model variables had been projected out through 1990 in the original database, the projected baseline values of some variables incorporated sharp cycles that would have affected the simulation results had CBO used them in unmodified form. CBO corrected these problems by extending the projected baseline figures through 1999 (CBO's simulation horizon), and by removing the cycles in the original figures.[18]

The Importance of Nonlinearity

The importance of nonlinear relationships in the U.S. and ROW sectors of the model should be kept in mind when interpreting the simulation results presented in Section III. These nonlinearities can significantly affect simulation results and comparisons among different simulations. Because of these nonlinearities, the responses of an economy to shocks when it is operating at nearly full capacity can be quite different from its responses when it is at a slack stage of the business cycle.

The importance of nonlinearity is that it prevents the analyst from generalizing about how different policies or other external developments might affect the economy. An example can be found in the question of how a change in the budget deficit affects real GNP. If the model were linear and implied that a deficit reduction of a given amount would affect GNP by, say, $10 billion, then one might also generalize easily that a deficit reduction twice as large would affect GNP by $20 billion. In a nonlinear model, however, such a generalization might be wrong: doubling the deficit reduction would not necessarily double the effect on GNP. In a naive sense, one might conclude that the combined GNP effect of a budget deficit reduction and a monetary policy change, each of which, taken by itself, affects GNP by $10 billion, would be $20 billion. In a nonlinear and simultaneous model, however, such a conclusion might be inaccurate, since the two policy actions would affect the economy and each other interactively.

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18. These data were obtained from the commercial econometric services of The WEFA Group and Data Resources, Inc. See Stephan Thurman, Tilman Ehrbeck, and Jeanne Dennis, "The U.S. Trade Deficit Equals the Rest of the World's Trade Surplus" (Congressional Budget Office, processed, 1989), pp. 14-17.

The Baseline Projection

The simulation results in Section III are stated as differences from CBO's January 1989 baseline projection of economic and budgetary conditions for the 1989-1994 period, shown in Table 7. For the purposes of this study, the baseline projections have been extended through 1999 as described below. As shown in the table, the budget deficit will decline gradually from $155 billion in fiscal year 1988 to $122 billion in fiscal year 1994 under current budgetary provisions, in the absence of further actions to meet the targets in the Balanced Budget Act. The corresponding baseline projection of the current account balance also entails a relatively gradual decline, from a deficit of $132 billion in 1988 to one of $75 billion in 1994.

Underlying these projections are assumptions that interest rates will decline relatively slowly from current levels, and that the exchange rate of the dollar--measured against the currencies of 10 major industrial countries, the FRB10--will depreciate gradually in nominal terms at an average rate of 2.9 percent a year between 1989 and 1994. Because inflation rates for the FRB10 are projected to be only slightly above U.S. rates--which are projected to average 4.6 percent a year over the next six years--this exchange rate projection represents a real depreciation of roughly 2.7 percent per year on average. Real GNP is projected to grow at 2.9 percent in 1989, but at a slower rate of 2.1 percent to 2.3 percent for the balance of the projection period.[19]

The exchange-rate depreciation and current-account deficit in the baseline projection reflect the concerns of some economists who argue that the current-account deficit will only be sustainable when it has been reduced sufficiently to hold the net foreign debt to the growth rate of GNP. If the debt were to grow persistently faster than GNP, according to one view, it would come to represent a disproportionate share of private financial portfolios and could give rise to damaging economic changes such as sharp depreciations of the dollar and spikes in interest rates. Accordingly, CBO has adopted as its exchange-rate projection the amount of depreciation needed to reduce the growth of the (negative) net foreign investment position of the United States to the growth rate of U.S. nominal GNP by 1995. The declining current-account deficit in the baseline reflects the slowing growth of U.S. debt. Any additional dollar depreciations or changes in the current-account deficit that are shown in simulations reported below are over and above the amounts already incorporated in the baseline.[20]

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19. CBO's August 1989 baseline projections of the current account deficit are likely to be larger in 1990 and 1991 than those described here because of the strong appreciation of the dollar in early 1989. This appreciation was unforeseen when the January projection was prepared.

20. The choice of 1995 as a target date to equalize the growth rates of external debt and nominal GNP is, of course, arbitrary. Choosing 1999, for example, would slow the imposed baseline trend rate of dollar depreciation and would consequently slow improvements in the baseline current-account deficit. One extreme viewpoint on this issue would claim that foreigners will continue to acquire U.S. assets indefinitely, thus requiring no trend dollar depreciation. As William Cline has demonstrated, using a similar model framework (*American Trade Adjustment: The Global Impact*, Institute for International Economics, Washington, D.C., March 1989), such a scenario would imply ever-increasing U.S. current-account deficits. See Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1990-1994* (January 1989), pp. 18-19. Also see Stephan Thurman, Tilman Ehrbeck, and Jeanne Dennis, "The U.S. Trade Deficit Equals the Rest of the World's

Since the concern of the present study is with simulated economic developments beyond the 1989-1994 period covered by the current CBO baseline projections, it was necessary to extend these projections in deriving a control simulation for this study.[21] In general, the characteristics of these extended projections are similar to those of the projections shown in Table 7. In particular, real GNP growth after 1994 was assumed to remain at roughly 2.3 percent a year, while the inflation rate was held between 4 percent and 4.5 percent. On the other hand, interest rates and exchange rates were assumed to remain stable. Finally, the budget deficit was kept constant at its projected 1994 share of GNP, and the current-account deficit was assumed to keep the external debt at its projected 1994 ratio to GNP.

TABLE 7. BASELINE BUDGET AND ECONOMIC PROJECTIONS (By calendar year, in billions of dollars unless otherwise noted)

	Actual	Projected					
	1988	1989	1990	1991	1992	1993	1994
Current-Account Deficit	132	129	126	119	108	93	75
Budget Deficit (Fiscal years)	155	155	141	140	135	129	122
Three-month Treasury Bill (Percent)	6.7	7.9	7.1	6.7	6.4	6.1	5.9
Ten-Year Government Bond Rate (Percent)	8.9	9.3	9.0	8.6	8.1	7.7	7.4
Dollar Exchange Rate (Percent change)	-4.3	-4.1	-3.0	-2.7	-2.5	-2.5	-2.5
Nominal GNP	4,859	5,209	5,542	5,902	6,281	6,685	7,117
Real GNP (Percent change)	3.8	2.9	2.1	2.2	2.2	2.3	2.3
Consumer Price Index (Percent change)	4.0	4.9	4.9	4.6	4.4	4.4	4.4

SOURCE: Congressional Budget Office, *The Economic and Budget Outlook, Fiscal Years 1990-1994* (January 1989).

Trade Surplus" (Congressional Budget Office, processed, 1989), pp. 5-7.

21. These "extended" projections do not represent CBO projections of future developments. They are simply technical extensions that permit the construction of a baseline simulation, which can be used to measure the changes in the current account and other important variables resulting from alternative policy actions over a longer time horizon.

SECTION III

SIMULATION RESULTS

This section presents the results of simulations designed to permit the properties of the Congressional Budget Office's adapted version of MINIMOD to be compared with those of the original MINIMOD. The simulations show the model's responses to the same policy changes that were used by the creators of MINIMOD, Haas and Masson, to demonstrate the properties of the original model.

The results of the simulations using the CBO version of the model differ at times from those based on the original model. In general, the real sectors of the CBO adaptation appear to be less volatile than their counterparts in the original model. This imparts more volatility to financial variables, such as exchange rates.

There are several reasons for the differences in simulation properties of the two models:

- The CBO version differs significantly from the original because it incorporates the SLUSIT current-account model with its different elasticities and greater detail, and because several other important equations and elasticities were modified, as described above.

- The baseline on which the CBO simulations were based was different than that used in the IMF simulations. This affects the results because the model is nonlinear and thus sensitive to baseline conditions. Since the policy changes were assumed to take effect in a different year in the CBO runs (1988) than in the original IMF simulations (1985), the degrees of excess capacity and the budget and trade deficits in the U.S. and ROW economies differed. Also, the first few years of the IMF baseline data contain cyclical swings that are not present in the CBO baseline. In any case, since the baseline data on which the original IMF runs were based are not available to CBO, there is no assurance that they are similar to those that CBO used.

- The CBO version of the model was run using different software, and as a result a number of technical differences arose, such as different normalizations of equations, different convergence criteria in the solution algorithms, and the like.

The simulations include a fiscal contraction in the United States, a fiscal expansion in the ROW, a monetary expansion in the United States, a monetary expansion in the ROW and an imposed autonomous dollar depreciation scenario. The Haas-Masson simulations were performed over the 1985-1990 period, whereas the CBO version was simulated over the 1988-1999 period. The vertical lines in the middle of the simulation graphs represent the end of the simulation period length

reported in Haas-Masson.[22] Since CBO's simulations are quite long, we should expect the endogenous variables in the simulations to approach their steady-state levels, unlike those in the shorter simulations done by Haas and Masson.

Each of the simulations presented below is performed with all exogenous policy variables other than that which drives the simulation held at their baseline paths. Thus, a U.S. fiscal contraction is analyzed assuming fixed U.S. and ROW monetary aggregate paths, and fixed ROW real government expenditures. Monetary stimulus in the U.S. is analyzed assuming fixed real government expenditures in the U.S. and ROW, and fixed money in the ROW.

SIMULATION 1: U.S. FISCAL CONTRACTION

In the first simulation, U.S. real government expenditures were permanently decreased by 1 percent of real GNP beginning in the third quarter of 1988. The policy action was sustained through 1999. This resulted in slightly more than a 5 percent permanent reduction in the level of real government expenditures. The economic effects of this policy change are displayed in Table A-1 and Figure A-1. The figures follow the same order as those reported in Haas and Masson's study. CBO, however, has added figures showing changes in the government and current-account deficits, variables that were not reported by Haas and Masson.

The fiscal contraction reduces interest rates in both the United States and ROW in both the adapted version of MINIMOD and in the original. The drop in the U.S. short-term rate is about 250 basis points, while Haas and Masson report roughly a 100 basis point decline in the original model. ROW interest rates decline 150 basis points in response to lower U.S. interest rates, a change similar to that reported by Haas and Masson. Since U.S. interest rates drop more than ROW rates, the dollar depreciates steadily in both versions of the model. After six years, its cumulative decline from baseline levels is 3.0 percent, whereas Haas and Masson reported only a 2.0 percent decline.

U.S. real GNP declines in the first quarter of the simulation as a result of the fiscal contraction, and then rises steadily. GNP rises above baseline levels after six years as a result of changes sensitive to interest rates. The corresponding Haas and Masson path for GNP only returns to baseline levels after six years. ROW real GNP, for its part, falls much less sharply in the CBO simulations than in Haas and Masson's results. Prices decline considerably more relative to baseline levels in both the U.S. and ROW sectors in the CBO simulation than in the Haas and Masson results. One would have expected the continuing dollar depreciation over the longer-term horizon in the combined model to have had more countervailing influence on U.S. inflation.

The responses of both the budget deficit and current-account deficit to the policy change appear reasonable, with the current account improving by roughly 30 percent of the improvement in the fiscal balance. The current account improves

22. The explanatory notes to the accompanying tables should be read carefully, especially as regards interpreting results for exchange rates, deficits, and the ratio differences from control.

more sharply toward the end of the simulation. This result is consistent with the changes in the fiscal and current-account deficits that are reported in other simulation studies.[23]

SIMULATION 2: ROW FISCAL EXPANSION

The second simulation involves a fiscal expansion in the ROW by increasing real ROW government expenditures by 1 percent of ROW GNP. The change in expenditures is sustained through 1999, and results ultimately in a 7.3 percent increase in real ROW government expenditures. The results of this experiment are displayed in Table A-2 and Figure A-2.

The ROW fiscal expansion puts somewhat stronger upward pressure on ROW interest rates in the CBO version of MINIMOD than is reported by Haas and Masson. The increases after six years are some 50 basis points larger than those of Haas and Masson. U.S. interest rates also rise slightly more in the CBO version than in the original model. The exchange rate depreciates steadily in both the CBO and the Haas and Masson versions.

The ROW real GNP effect appears roughly the same in the CBO version as in the Haas and Masson model. Real ROW GNP peaks at 1.5 percent above baseline after a few years, and falls back to 1 percent above baseline after the six-year Haas and Masson horizon. At the end of the 10-year CBO simulations the difference from baseline levels is negligible.

The responses of rest-of-world prices in the CBO simulation appear to be comparable to those reported by Haas and Masson, but U.S. prices rise more strongly in the CBO simulation. Where Haas and Masson have a very low and flat U.S. price response on the order of 0.1 percent above baseline, prices in the CBO simulation reach a level 1.2 percent above baseline by 1995, and increase steadily to 2.5 percent above baseline by the end of the simulation in 1999.[24]

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23. See Paul Masson, Steven Symansky, Richard Haas, and Michael Dooley, "MULTIMOD: A Multi-Region Econometric Model," Staff Studies for the World Economic Outlook (Washington, D.C.: International Monetary Fund, 1988).

24. A plausible explanation for this significant difference in model results may be found in the models' structure and in their different simulation periods. As mentioned earlier, the slightly stronger CBO U.S. interest rate effect enters the U.S. investment sector, which is somewhat more sensitive to interest rates than that of the Haas-Masson model. The resultant relatively lower U.S. capital stock would lower U.S. capacity output, relative to that of Haas and Masson, yielding relatively higher capacity utilization rates. Also, it will be recalled that the CBO simulation period is one of a significantly higher output usage rate than that of the Haas-Masson period. Both of these effects, operating within a nonlinear model framework, would yield the difference in simulated "spill-over" effects with regard to inflationary responses. While the explanation is plausible and yields insights into the potential differences in model response from two similarly structured models, it must be recognized as conjecture since the sector detail from the Haas-Masson model is unavailable.

SIMULATION 3: U.S. NOMINAL MONETARY EXPANSION

In the third simulation, the U.S. monetary base is increased by 1 percent each quarter for the four quarters beginning in 1988:3, reaching a level 4 percent higher than in the baseline by 1989:2. This percentage difference is then maintained through 1999. The results of this experiment are displayed in Table A-3 and Figure A-3.

Interest and exchange rate responses to the shock in the CBO version of the model are comparable to those found in Haas and Masson. Both models show a sharp downward "spike" in short-term rates at the beginning of the simulation, though the spike is larger in the CBO simulation. The exchange rate ultimately depreciates by 3.4 percent by 1995 in the CBO simulation, a result consistent with the Haas and Masson model.

Real U.S. GNP responds more quickly to the monetary stimulus in the CBO simulation than in the original, though this strength is short-lived. The effects of the U.S. monetary stimulus on ROW GNP are small and initially negative, as was the case in the Haas and Masson results. The U.S. monetary expansion produces a 1.9 percent higher U.S. price level by 1995 in the CBO version of the model, slightly higher than the results reported by Haas and Masson. In the ROW sector, prices decline by as much as 0.5 percent by 1995, but then begin to return to baseline.

Both the budget and current-account deficits ultimately improve in response to the monetary stimulus. The U.S. current-account balance deteriorates relative to baseline through 1993, but rises above baseline levels in 1994 and 1995. As would be expected, the current-account effects are quite small relative to those produced by the simulated budget deficit reduction discussed above, as the monetary stimulus produces more competitive external prices through exchange-rate depreciation, offset by higher aggregate demand, which pulls in more imports. The budget deficit improves markedly early in the simulation, as interest costs are reduced and higher disposable income increases the tax base. These fiscal effects level off by 1995.

SIMULATION 4: ROW MONETARY EXPANSION

Monetary stimulation in the rest-of-world sector is considered in the fourth simulation. The ROW monetary base is increased by one percentage point over baseline in each of the first four quarters of simulation (1988:3-1989:2), and is maintained at that level through 1999. The results of this policy action are shown in Table A-4 and Figure A-4.

Interest rates in the ROW sector decline rapidly by 250 basis points in response to the monetary stimulus, and level off to 140 basis points difference from baseline shortly thereafter. U.S. short-term rates, by contrast, decline monotonically to 100 basis points below baseline after 10 years. The interest-rate differential causes the dollar exchange rate ultimately to appreciate by over 4 percent in the CBO simulation. Haas and Masson, by contrast, report an appreciation of only slightly over 2.5 percent. This is the result of the Haas-Masson model's ROW sector

interest rate responses which return toward baseline levels after six years, thereby narrowing the interest-rate differential.

Unlike the reported Haas and Masson results, the CBO MINIMOD version displays a neutral response of ROW real GNP and prices to monetary stimulation. That is, prices rise following increases in the monetary base, while real GNP ultimately returns to its baseline level. This result obtains because of CBO's modifications of the ROW investment and consumption equations, which were described earlier. Prices in the ROW sector ultimately are 1.3 percent higher than baseline levels by the end of the simulation. U.S. prices decline by almost the same magnitude in 10 years, as the 4 percent dollar appreciation more than offsets the effect of higher ROW prices on U.S. import prices. In the original MINIMOD simulation results, both U.S. and ROW price responses to the monetary stimulus were about two-thirds of those for the CBO version. U.S. GNP effects are small in both models, indicating the offsetting influences of deteriorating net exports on the one hand, and lower U.S. interest rates on the other.

The U.S. budget deficit improves and the current account deteriorates in this simulation. Lower prices and reduced interest costs reduce the budget deficit. The 4 percent dollar appreciation causes the U.S. external balance to deteriorate by over $30 billion by simulation's end.

SIMULATION 5: AUTONOMOUS DEPRECIATION OF THE DOLLAR

Movements in the exchange rate of the dollar are not always tied to specific fiscal or monetary policy actions. Often, they occur as a result of shifts in investors' preferences regarding investments in different currencies. If, as some have argued, more dollar depreciation is necessary to improve the current account significantly, the obvious question is how much more depreciation would be needed. In particular, it would be helpful to know how much depreciation is needed, in the absence of fiscal or monetary policy actions, to prevent external debt from rising relative to output.

In an earlier study, CBO reported simulation results concerning the dollar depreciation that would be required to reverse the persistent current-account deficits projected over the next half decade in the absence of countervailing economic forces.[25] These results were obtained by simulating a stand-alone (partial equilibrium) version of the SLUSIT current account model.

The earlier analysis necessarily left out of consideration certain important channels through which exchange rates affect the current account. These include the response of both domestic and foreign GNP to the depreciation, among other channels. Changes in exchange rates affect these variables, which in turn affect the current account. The more fully specified economic model used in the present study allows these considerations to be taken into account.

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25. Edward M. Gramlich, statement before the Joint Economic Committee, Congress of the United States, November 5, 1987.

To address these aspects, CBO followed the technique used in the original Haas-Masson MINIMOD simulations. CBO assumed that foreigners will demand a risk premium for holding U.S. assets, over and above the difference between the returns on holding their own assets versus those of the United States. This may be viewed in an economic context, as was more crudely assumed in the earlier study, as a loss in confidence in dollar-denominated U.S. assets by foreigners. The imposed risk premium--introduced as a constant adjustment to the interest rate parity condition equation--compensates foreign investors for the risk they associate ywith the loss of confidence.[26] All policy variables are held constant in this simulation at their baseline values.

The exchange rate does indeed have its desired effect on the U.S. external balance, while real GNP is roughly unchanged. The 1 percent risk premium ultimately results in a 2.1 percent depreciation of the dollar. By simulation's end, the current account has improved by 0.2 percent of nominal GNP and real net exports have improved by 0.2 percent of real GNP. All other components of real GNP decline as shares in the total. The fiscal deficit-to-GNP ratio is also worsened as higher interest rates increase outlays for interest.

For the most part, these CBO simulation results are comparable to those reported by Haas and Masson. Short-term U.S. interest rates in the CBO simulation, however, rise slightly more than in the original model (0.3 percentage points in CBO versus 0.1 in Haas-Masson through six years). This difference in result, in part, accounts for a somewhat more moderate exchange-rate depreciation over the six-year horizon in the CBO version (1.6 percent versus around 2 percent in Haas-Masson). In the original version of the model as in CBO's version, improvement in real net exports is offset by declines in other interest-sensitive real GNP components and results in virtually unchanged real U.S. GNP.

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26. Changing the residual tracking variable is justifiable in an econometric modeling context when all other variables included in the equation are endogenously determined elsewhere in the model, and the residual term is considered to represent a change in the relationship from outside the model determination. In this instance, the change in risk perceptions increases the residual error. Alternatively, a decrease in the risk parameter might be viewed as a "risk discount" on dollar denominated assets. Such a discount would occur when, despite a narrowing of the U.S.-foreign interest rate differential, foreign investors would increase their holdings of U.S. assets, indicating a revealed preference for the financial security of U.S.-based investments.

APPENDIXES

APPENDIX A

TABLES AND FIGURES SHOWING SIMULATION RESULTS

- For purposes of comparison to previously published results, the exchange rate in the figures is MINIMOD's dollar price of foreign currency. Hence, a depreciation in this effective index is indicated by an increase relative to baseline. In the tables, on the othe hand, the effective exchange rate index is SLUSIT's foreign currency price of the dollar where a depreciation is indicated by a decrease relative to baseline. Both effective indexes are constructed as described in the text.

- Both the government and current-account deficits are negative numbers in this model. Hence, a decrease (improvement) in either deficit has a positive difference from baseline and an increase (deterioration) has a negative difference from baseline.

- Simulation results for any variable x as it is compared to its baseline value bx are shown in the tables as:

  (pd) Percentage difference from baseline, calculated as

  $pd_x = (x/bx - 1) * 100.$

  (rd) Ratio difference from baseline, calculated as

  $rd_x = (x/y - bx/by) * 100,$

  where y and by are real or nominal GNP levels where applicable, and

  (d) Level difference from baseline, calculated as

  $d_x = x - bx,$

  where the levels are in percentage points for interest rates, billions of 1982 dollars for U.S. real net exports, billions of 1972 dollars for ROW real net exports, and billions of current dollars for U.S. and ROW budget and current account deficits.

- Some thought must be given to interpretation of the ratio difference from baseline results in some instances. When a sector such as consumption increases relative to baseline, but the total GNP measure decreases relative to baseline, the difference in ratio percentage points may indeed increase. Intuitively, one might think of the consumption ratio difference increase relative to baseline as indicating the sector's larger share of a smaller total.

TABLE A-1. SIMULATED ECONOMIC EFFECTS OF REDUCING FEDERAL EXPENDITURES BY 1 PERCENT OF GNP--$50 BILLION IN 1989 (Percentage difference from baseline levels except for variables marked (d), which are differences from baseline)

Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	-1.5	-1.5	-1.2	-0.9	-0.5	-0.1	0.3	0.6	1.0	1.3	1.6
--Consumption...(pd)	-0.8	-1.1	-1.0	-0.9	-0.7	-0.5	-0.3	-0.0	0.2	0.4	0.6
--Investment....(pd)	-2.0	-1.8	-0.9	-0.0	0.9	1.9	2.8	3.7	4.6	5.4	6.1
--Government....(pd)	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1	-5.1
--Net Exports...(d).	12.9	18.2	22.7	27.3	32.2	37.5	43.2	49.5	56.4	63.0	69.3
Price Level.....(pd)	-0.2	-0.5	-1.0	-1.5	-2.0	-2.5	-3.0	-3.5	-3.9	-4.2	-4.5
Short-Term Rate..(d)	-1.4	-1.7	-1.9	-2.1	-2.2	-2.4	-2.5	-2.6	-2.7	-2.7	-2.6
Long-Term Rate...(d)	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4	-0.4	-0.5
Current Acct....(d).	11.0	14.7	17.9	21.3	25.1	29.4	34.3	39.8	46.5	54.0	62.0
Govt.Deficit....(d).	33.1	38.9	49.0	61.2	75.2	90.6	107.2	124.3	142.3	161.1	180.6
ROW SECTOR											
Real GNP.....(pd)	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.3	0.4
--Consumption...(pd)	-0.1	-0.1	-0.0	0.1	0.2	0.4	0.6	0.8	1.0	1.2	1.4
--Investment....(pd)	-0.1	-0.1	-0.1	0.0	0.2	0.4	0.7	1.1	1.4	1.8	2.3
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	-2.5	-3.6	-4.6	-5.4	-6.3	-7.1	-7.9	-8.7	-9.6	-10.4	-11.1
Price Level.....(pd)	-0.1	-0.2	-0.3	-0.6	-0.8	-1.1	-1.4	-1.7	-2.1	-2.4	-2.8
Short-Term Rate..(d)	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-0.9	-1.0	-1.2	-1.3	-1.5
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
Current Acct....(d).	-8.7	-11.4	-13.4	-15.4	-17.2	-18.9	-20.6	-22.8	-25.8	-29.3	-32.9
Govt.Deficit....(d).	-2.9	-4.2	-4.8	-5.2	-5.6	-5.9	-6.3	-7.8	-8.5	-9.3	-10.2
Exchange Rates.....											
MINIMOD4.....(pd)	-0.6	-1.2	-1.7	-2.3	-2.8	-3.2	-3.7	-4.3	-4.9	-5.4	-5.9
FRB6.....(pd)	-0.6	-1.2	-1.7	-2.3	-2.8	-3.2	-3.7	-4.3	-4.9	-5.4	-5.9
NIC8.....(pd)	-0.7	-1.2	-1.7	-2.3	-2.8	-3.3	-3.7	-4.3	-4.9	-5.4	-5.9
FRB18.....(pd)	-0.6	-1.2	-1.7	-2.3	-2.8	-3.2	-3.7	-4.3	-4.9	-5.4	-5.9

SOURCE: Congressional Budget Office simulations described in text.

NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

TABLE A-1a: SIMULATED ECONOMIC EFFECTS OF REDUCING FEDERAL EXPENDITURES BY 1 PERCENT OF GNP--$50 BILLION IN 1989 (Difference in percentage of GNP from baseline levels, except for variables marked (pd), which percentage differences from baseline, and marked (d), which are differences from baseline)

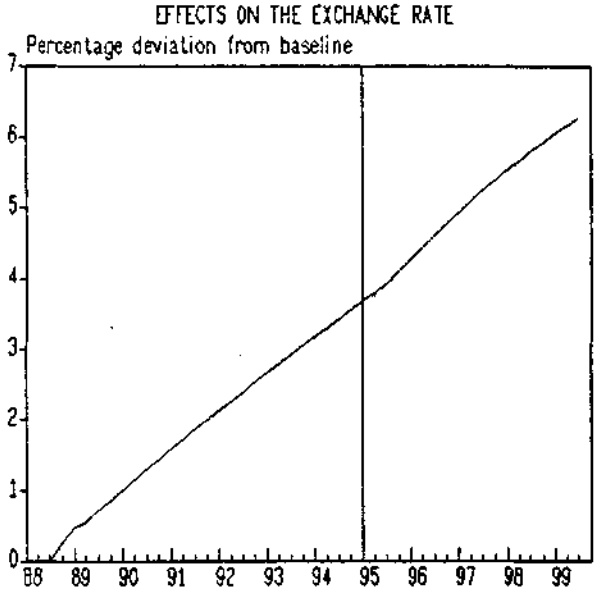
Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	-1.5	-1.5	-1.2	-0.9	-0.5	-0.1	0.3	0.6	1.0	1.3	1.6
--Consumption...(rd)	0.5	0.3	0.1	-0.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.6
--Investment....(rd)	-0.1	-0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8
--Government....(rd)	-0.7	-0.7	-0.8	-0.8	-0.9	-1.0	-1.1	-1.1	-1.2	-1.2	-1.3
--Net Exports...(rd)	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3
Price Level.....(pd)	-0.2	-0.5	-1.0	-1.5	-2.0	-2.5	-3.0	-3.5	-3.9	-4.2	-4.5
Short-Term Rate..(d)	-1.4	-1.7	-1.9	-2.1	-2.2	-2.4	-2.5	-2.6	-2.7	-2.7	-2.6
Long-Term Rate...(d)	-0.1	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.4	-0.4	-0.5
Current Acct....(rd)	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6
Govt.Deficit....(rd)	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.9
ROW SECTOR											
Real GNP.....(pd)	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.0	0.1	0.3	0.4
--Consumption...(rd)	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6
--Investment....(rd)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
--Government....(rd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.1
--Net Exports...(rd)	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4	-0.5	-0.5	-0.5	-0.6
Price Level.....(pd)	-0.1	-0.2	-0.3	-0.6	-0.8	-1.1	-1.4	-1.7	-2.1	-2.4	-2.8
Short-Term Rate..(d)	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-0.9	-1.0	-1.2	-1.3	-1.5
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
Current Acct....(rd)	-0.2	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4	-0.4	-0.4	-0.4	-0.5
Govt.Deficit....(rd)	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Exchange Rates.....											
MINIMOD4.....(pd)	-0.6	-1.2	-1.7	-2.3	-2.8	-3.2	-3.7	-4.3	-4.9	-5.4	-5.9
FRB6.....(pd)	-0.6	-1.2	-1.7	-2.3	-2.8	-3.2	-3.7	-4.3	-4.9	-5.4	-5.9
NIC8.....(pd)	-0.7	-1.2	-1.7	-2.3	-2.8	-3.3	-3.7	-4.3	-4.9	-5.4	-5.9
FRB10.....(pd)	-0.6	-1.2	-1.7	-2.3	-2.8	-3.2	-3.7	-4.3	-4.9	-5.4	-5.9

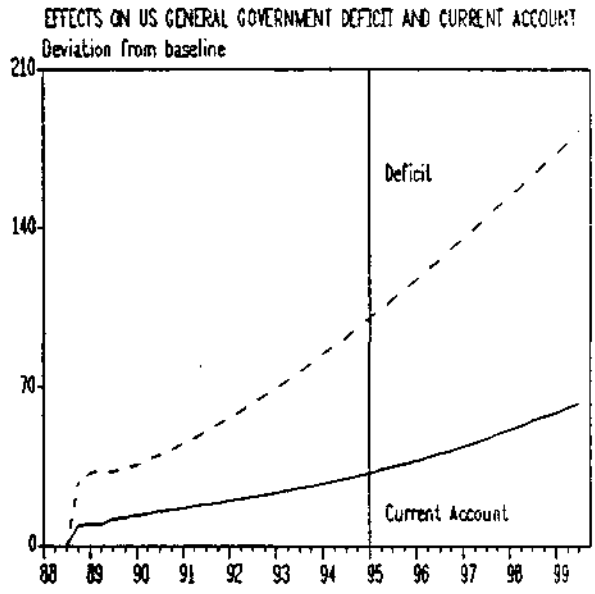
SOURCE: Congressional Budget Office simulations described in text.

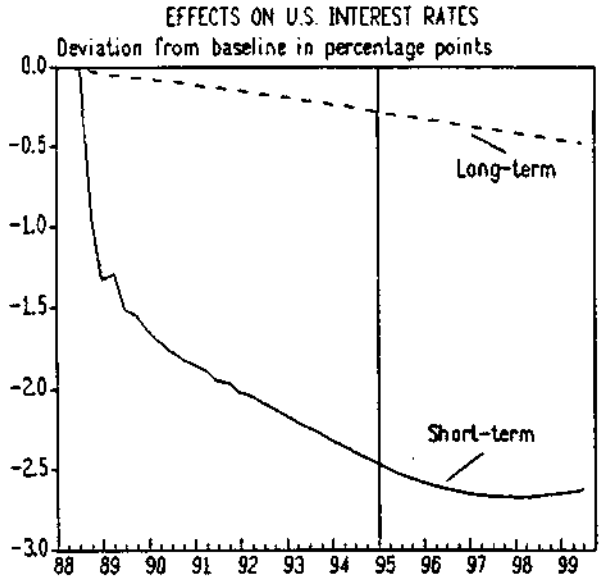
NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

FIGURES A-1. SIMULATED ECONOMIC EFFECTS OF REDUCING FEDERAL EXPENDITURES BY 1 PERCENT OF GNP--$50 BILLION IN 1989







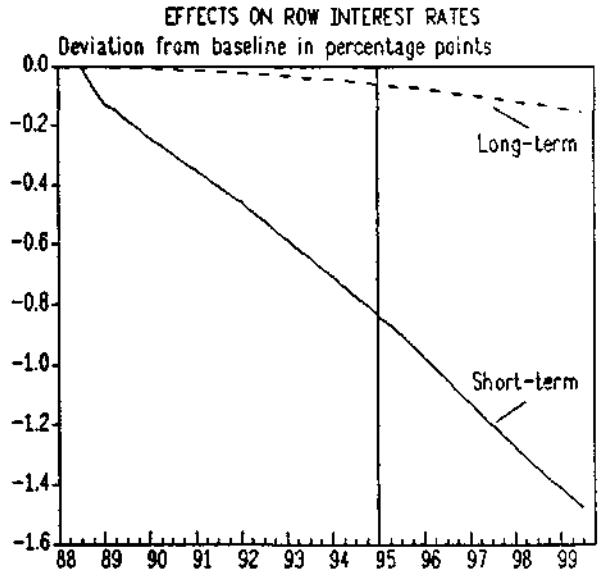
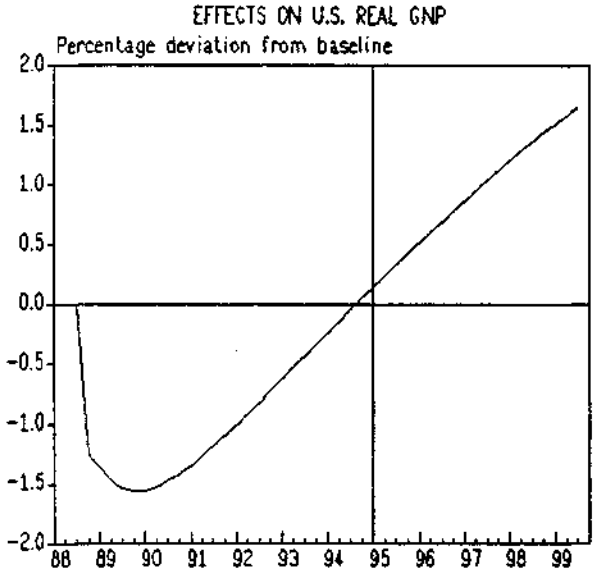
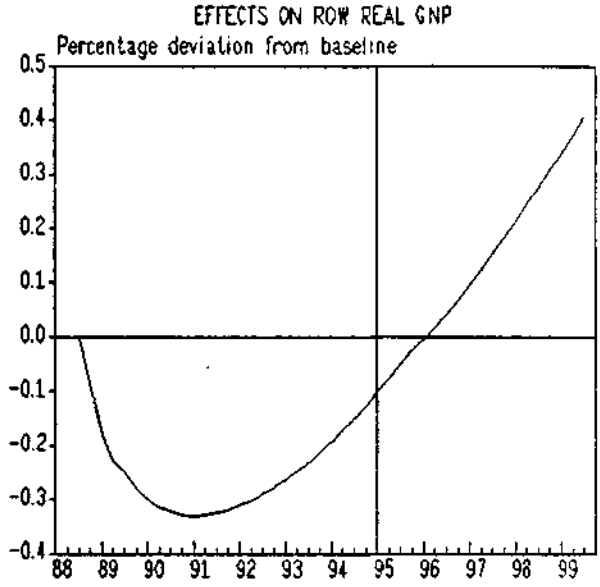
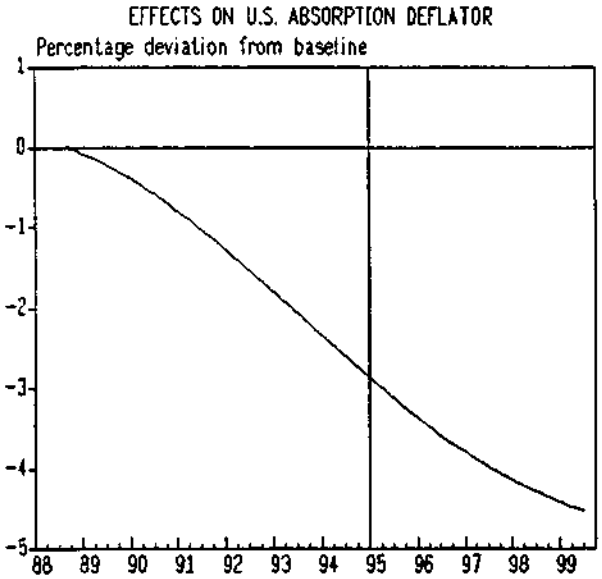
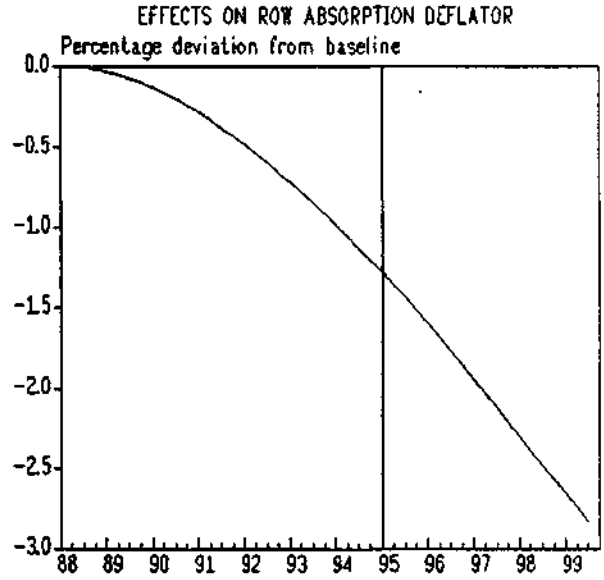


FIGURE A-1. CONTINUED









SOURCE: Congressional Budget Office simulations described in text.

TABLE A-2: SIMULATED ECONOMIC EFFECTS OF INCREASING REST-OF-WORLD GOVERNMENT EXPENDITURES BY 1 PERCENT OF REST-OF-WORLD GNP (Percentage difference from baseline levels except for variables marked (d), which are differences from baseline)

Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	0.3	0.4	0.4	0.4	0.3	0.3	0.2	0.1	0.1	-0.0	-0.1
--Consumption...(pd)	0.1	0.2	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.0	-0.0
--Investment....(pd)	0.3	0.4	0.3	0.1	-0.1	-0.4	-0.7	-1.1	-1.5	-2.0	-2.4
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	7.0	9.5	11.9	14.4	17.1	20.1	23.4	26.9	30.8	35.1	39.6
Price Level.....(pd)	0.0	0.1	0.3	0.4	0.7	0.9	1.2	1.5	1.9	2.2	2.6
Short-Term Rate..(d)	0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.2
Long-Term Rate...(d)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3
Current Acct....(d).	7.4	9.7	12.1	14.6	17.8	21.9	27.0	33.1	40.3	48.7	58.6
Govt.Deficit....(d).	3.5	4.4	4.2	3.2	1.4	-1.1	-4.4	-8.3	-12.6	-17.5	-22.9
ROW SECTOR											
Real GNP.....(pd)	1.4	1.5	1.5	1.4	1.2	1.0	0.8	0.6	0.4	0.1	-0.1
--Consumption...(pd)	0.8	0.9	0.9	0.7	0.5	0.3	0.0	-0.3	-0.6	-0.9	-1.2
--Investment....(pd)	0.7	1.3	1.3	1.0	0.6	0.1	-0.5	-1.2	-1.9	-2.6	-3.4
--Government....(pd)	7.2	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3
--Net Exports...(d).	-1.1	-1.3	-1.5	-1.7	-2.0	-2.2	-2.5	-2.8	-3.3	-3.8	-4.4
Price Level.....(pd)	0.1	0.3	0.6	1.0	1.4	1.9	2.4	3.0	3.6	4.2	4.8
Short-Term Rate..(d)	0.7	0.9	1.1	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.7
Long-Term Rate...(d)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3
Current Acct....(d).	-6.7	-7.3	-8.8	-10.3	-11.9	-13.9	-16.3	-19.4	-23.4	-28.0	-33.4
Govt.Deficit....(d).	-20.4	-19.2	-19.7	-21.0	-22.4	-23.9	-25.4	-27.7	-29.7	-31.6	-33.7
Exchange Rates.....											
MINIMOD4.....(pd)	-0.3	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
FRB6.....(pd)	-0.3	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
NIC8.....(pd)	-0.3	-0.5	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
FRB18.....(pd)	-0.3	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2

SOURCE: Congressional Budget Office simulations described in text.

NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

TABLE A-2a: SIMULATED ECONOMIC EFFECTS OF INCREASING REST-OF-WORLD GOVERNMENT EXPENDITURES BY 1 PERCENT OF REST-OF-WORLD GNP (Difference in percentage of GNP from baseline levels, except for variables marked (pd), which are percentage differences from baseline, and marked (d), which are differences from baseline in billions of dollars)

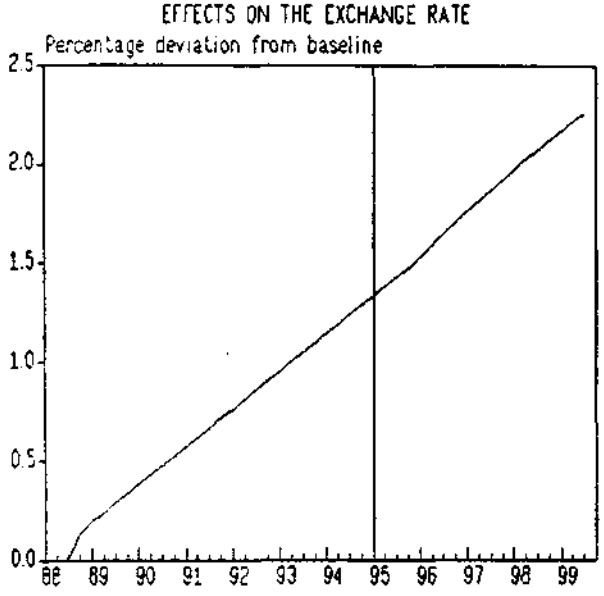
Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	0.3	0.4	0.4	0.4	0.3	0.3	0.2	0.1	0.1	-0.0	-0.1
--Consumption...(rd)	-0.1	-0.1	-0.1	-0.1	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0
--Investment....(rd)	0.0	0.0	-0.0	-0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.4
--Government....(rd)	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.0	-0.0	-0.0	0.0	0.0
--Net Exports...(rd)	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8
Price Level.....(pd)	0.0	0.1	0.3	0.4	0.7	0.9	1.2	1.5	1.9	2.2	2.6
Short-Term Rate..(d)	0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.2
Long-Term Rate...(d)	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.3
Current Acct....(rd)	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5
Govt.Deficit....(rd)	0.1	0.1	0.1	0.1	0.0	0.0	-0.0	-0.1	-0.1	-0.2	-0.2
ROW SECTOR											
Real GNP.....(pd)	1.4	1.5	1.5	1.4	1.2	1.0	0.8	0.6	0.4	0.1	-0.1
--Consumption...(rd)	-0.4	-0.3	-0.3	-0.4	-0.4	-0.4	-0.5	-0.5	-0.5	-0.6	-0.6
--Investment....(rd)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2
--Government....(rd)	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0
--Net Exports...(rd)	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Price Level.....(pd)	0.1	0.3	0.6	1.0	1.4	1.9	2.4	3.0	3.6	4.2	4.8
Short-Term Rate..(d)	0.7	0.9	1.1	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.7
Long-Term Rate...(d)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3
Current Acct....(rd)	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4
Govt.Deficit....(rd)	-0.5	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Exchange Rates.....											
MINIMOD4.....(pd)	-0.3	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
FRB6.....(pd)	-0.3	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
NIC8.....(pd)	-0.3	-0.5	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2
FRB16.....(pd)	-0.3	-0.4	-0.6	-0.8	-1.0	-1.2	-1.4	-1.6	-1.8	-2.0	-2.2

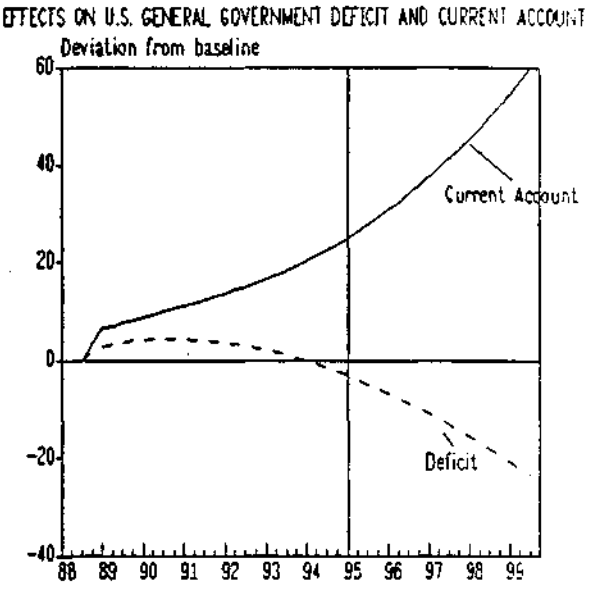
SOURCE: Congressional Budget Office simulations described in text.

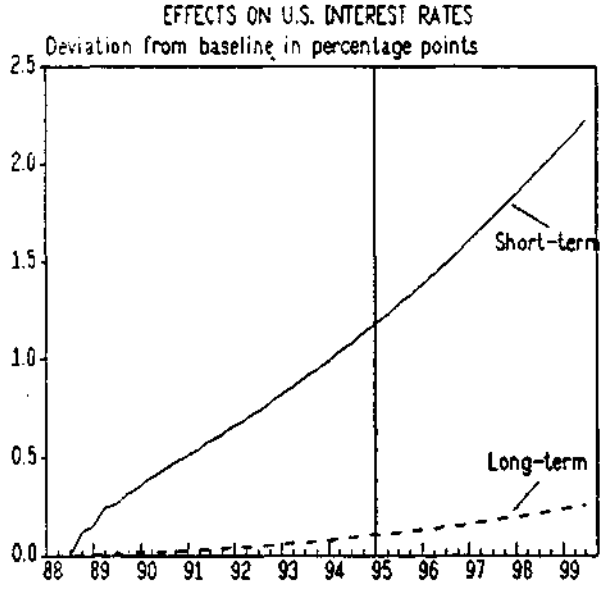
NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

FIGURE A-2. SIMULATED ECONOMIC EFFECTS OF INCREASING REST-OF-WORLD GOVERNMENT EXPENDITURES BY 1 PERCENT OF REST-OF-WORLD GNP







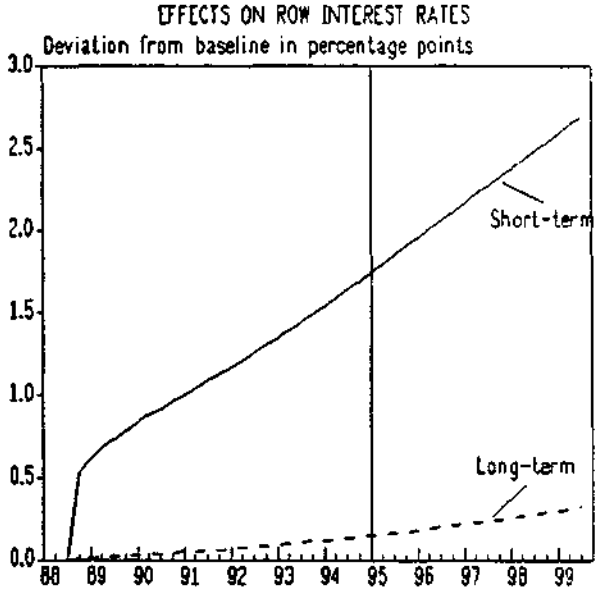
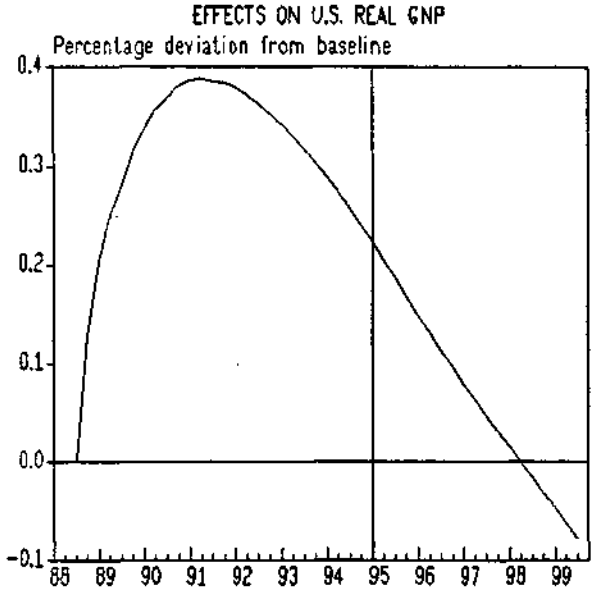
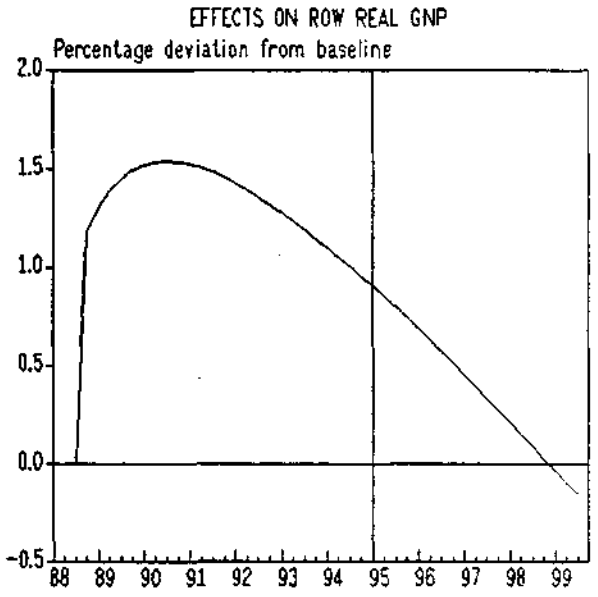
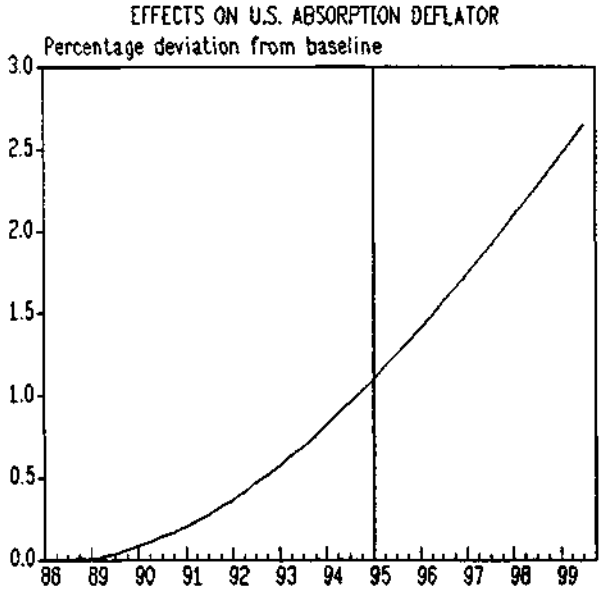
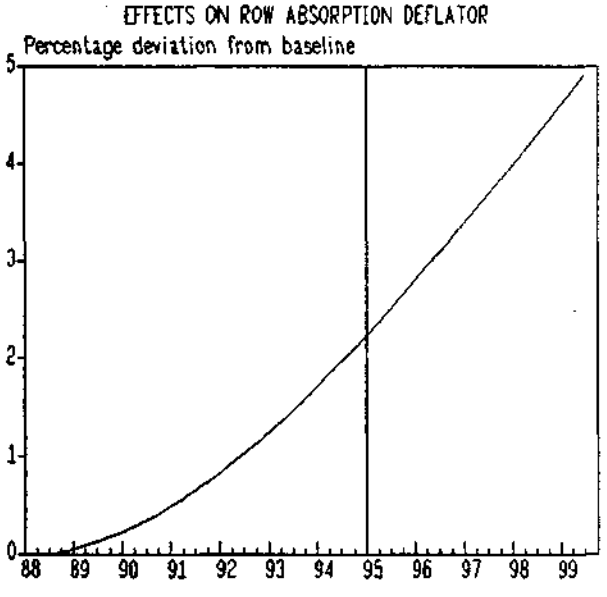


FIGURE A-2. CONTINUED









SOURCE: Congressional Budget Office simulations described in text.

TABLE A-3. SIMULATED ECONOMIC EFFECTS OF A GRADUAL INCREASE IN THE U.S. MONETARY BASE BY 4 PERCENT (Percentage difference from baseline levels except for variables marked (d), which are differences from baseline)

Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	0.7	0.9	1.2	1.3	1.4	1.3	1.2	1.1	0.9	0.7	0.5
--Consumption...(pd)	0.1	0.3	0.5	0.7	0.8	0.8	0.8	0.8	0.7	0.6	0.5
--Investment....(pd)	1.5	2.4	3.1	3.5	3.6	3.6	3.4	3.1	2.7	2.3	1.9
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	-2.9	2.4	3.4	4.0	3.9	3.0	1.4	-0.5	-2.3	-4.4	-6.6
Price Level.....(pd)	0.0	0.1	0.3	0.6	1.0	1.4	1.9	2.3	2.8	3.2	3.6
Short-Term Rate..(d)	-3.0	-2.4	-1.9	-1.5	-1.2	-0.9	-0.6	-0.3	-0.1	0.1	0.3
Long-Term Rate...(d)	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Current Acct....(d).	-7.4	-3.4	-2.8	-1.8	-0.5	0.6	1.6	2.5	3.7	4.8	5.8
Govt.Deficit....(d).	30.3	32.4	38.9	43.0	45.5	46.6	46.3	45.0	43.3	41.1	38.5
ROW SECTOR											
Real GNP.....(pd)	-0.2	-0.1	-0.1	-0.0	0.1	0.1	0.2	0.2	0.2	0.3	0.2
--Consumption...(pd)	-0.1	0.0	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.2
--Investment....(pd)	0.0	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.7	0.7
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	-2.2	-2.3	-2.4	-2.2	-1.8	-1.4	-0.8	-0.2	0.3	0.8	1.4
Price Level.....(pd)	-0.1	-0.2	-0.3	-0.4	-0.4	-0.5	-0.5	-0.5	-0.4	-0.3	-0.2
Short-Term Rate..(d)	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.0	0.0
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Current Acct....(d).	4.1	0.6	-0.1	-0.8	-1.3	-1.5	-1.5	-1.5	-1.8	-2.0	-2.3
Govt.Deficit....(d).	-2.0	-1.9	-1.4	-0.8	-0.3	0.2	0.7	0.9	1.3	1.8	2.3
Exchange Rates.....											
MINIMOD4.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2
FRB6.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2
NIC8.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2
FRB18.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2

SOURCE: Congressional Budget Office simulations described in text.

NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

TABLE A-3a: SIMULATED ECONOMIC EFFECTS OF A GRADUAL INCREASE IN THE U.S. MONETARY BASE BY 4 PERCENT (Difference in percentage of GNP from baseline levels, except for variables marked (pd), which are percentage differences from baseline, and marked (d), which are differences from baseline)

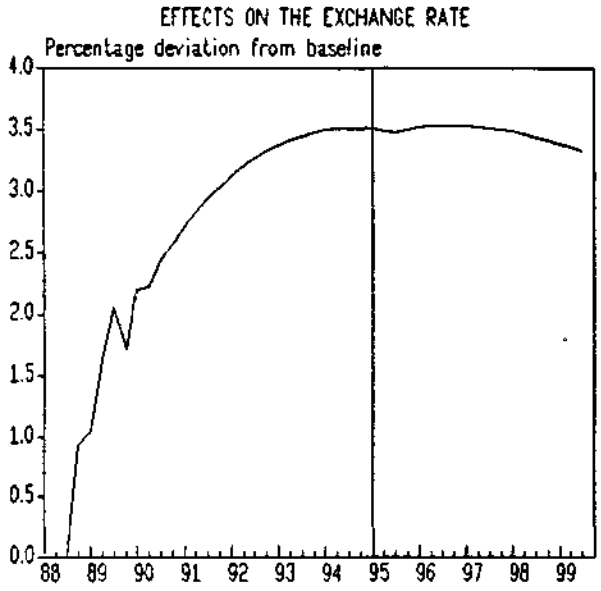
Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	0.7	0.9	1.2	1.3	1.4	1.3	1.2	1.1	0.9	0.7	0.5
--Consumption...(rd)	-0.4	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2	-0.1	-0.1	-0.0
--Investment....(rd)	0.1	0.2	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.2
--Government....(rd)	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.1	-0.1
--Net Exports...(rd)	-0.1	0.1	0.1	0.1	0.1	0.1	0.0	-0.0	-0.1	-0.1	-0.1
Price Level.....(pd)	0.0	0.1	0.3	0.6	1.0	1.4	1.9	2.3	2.8	3.2	3.6
Short-Term Rate..(d)	-3.0	-2.4	-1.9	-1.5	-1.2	-0.9	-0.6	-0.3	-0.1	0.1	0.3
Long-Term Rate...(d)	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2
Current Acct....(rd)	-0.1	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Govt.Deficit....(rd)	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.6	0.5	0.5	0.4
ROW SECTOR											
Real GNP.....(pd)	-0.2	-0.1	-0.1	-0.0	0.1	0.1	0.2	0.2	0.2	0.3	0.2
--Consumption...(rd)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	-0.0
--Investment....(rd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Government....(rd)	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
--Net Exports...(rd)	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.0	-0.0	0.0	0.0	0.1
Price Level.....(pd)	-0.1	-0.2	-0.3	-0.4	-0.4	-0.5	-0.5	-0.5	-0.4	-0.3	-0.2
Short-Term Rate..(d)	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.0	0.0
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Current Acct....(rd)	0.1	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Govt.Deficit....(rd)	-0.1	-0.1	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0	0.0	0.0
Exchange Rates.....											
MINIMOD4.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2
FRB6.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2
NIC8.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2
FRB18.....(pd)	-1.6	-2.3	-2.8	-3.1	-3.3	-3.4	-3.4	-3.4	-3.4	-3.3	-3.2

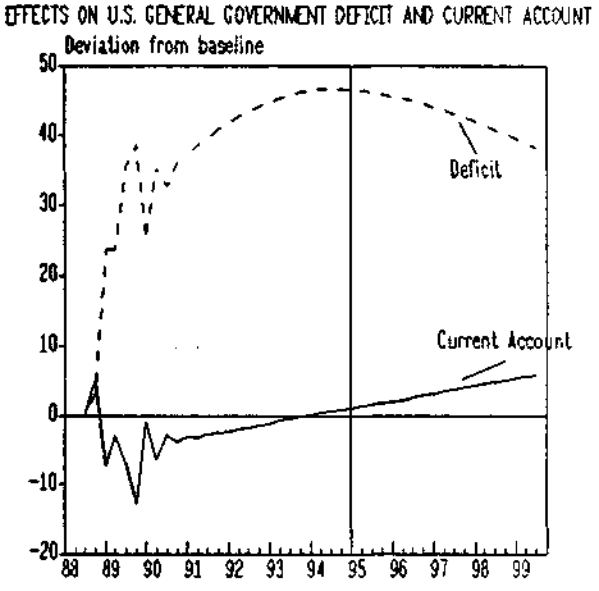
SOURCE: Congressional Budget Office simulations described in text.

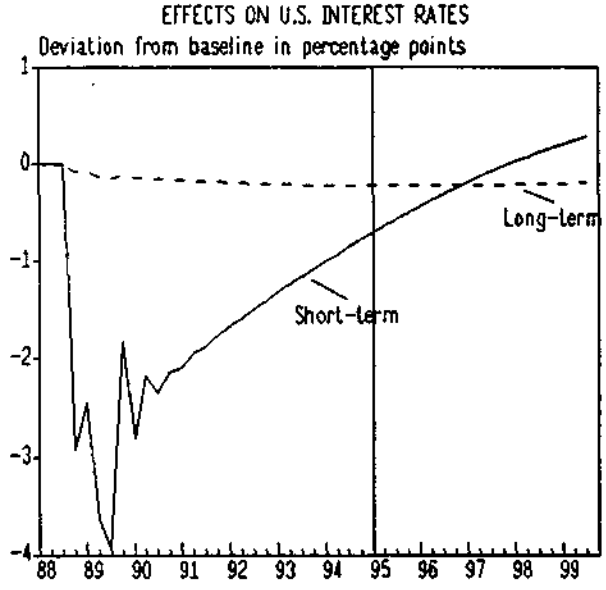
NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

FIGURE A-3. SIMULATED ECONOMIC EFFECTS OF A GRADUAL INCREASE IN U.S. MONETARY BASE BY 4 PERCENT







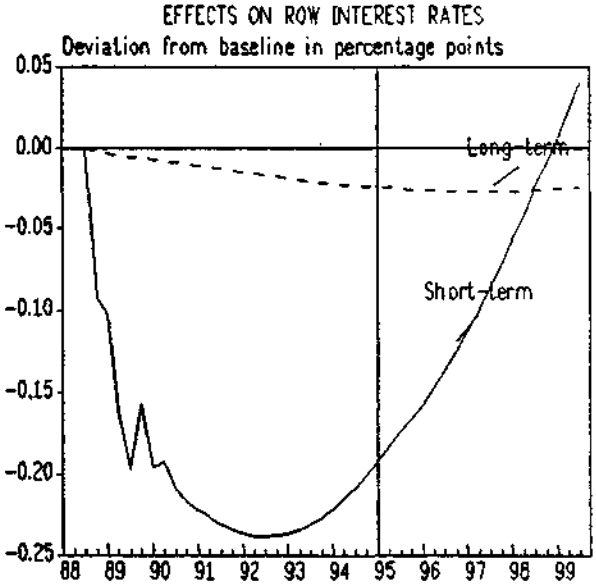
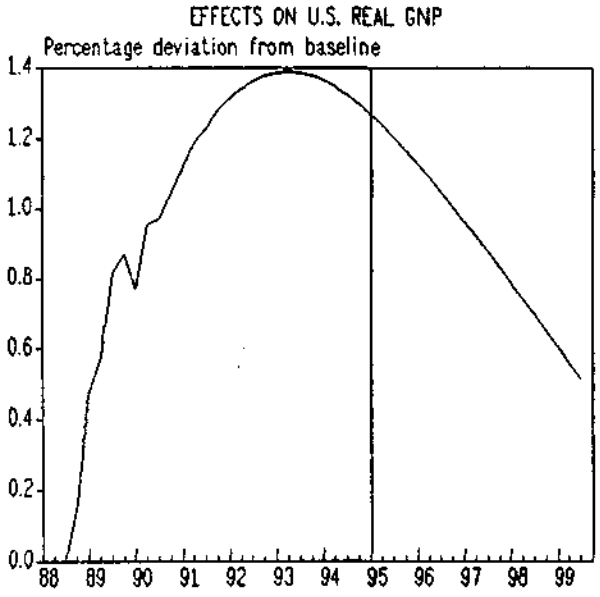
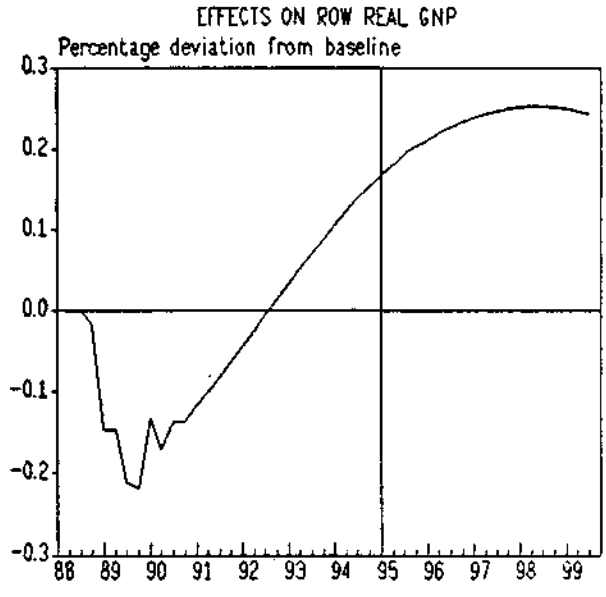
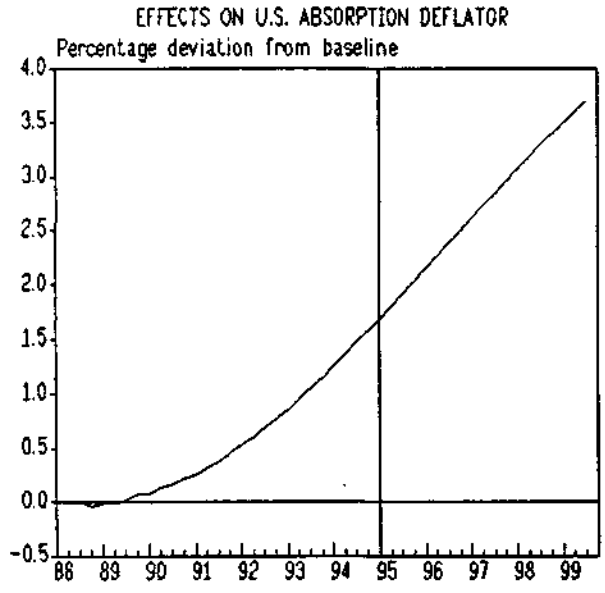
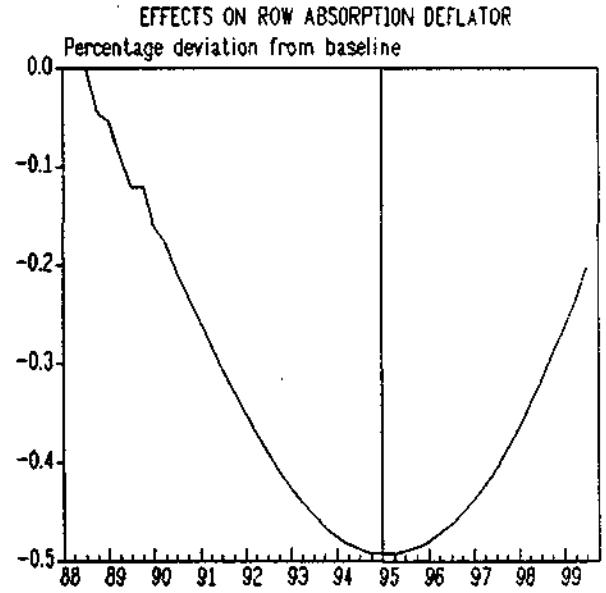


FIGURE A-3. CONTINUED









SOURCE: Congressional Budget Office simulations described in text.

TABLE A-4. SIMULATED ECONOMIC EFFECTS OF A GRADUAL INCREASE IN THE REST-OF-WORLD MONETARY BASE BY 4 PERCENT (Percentage difference from baseline levels except for variables marked (d), which are differences from baseline)

Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.0	0.0	0.0
--Consumption...(pd)	0.0	0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.0	-0.0	-0.0
--Investment....(pd)	0.0	-0.1	-0.1	-0.1	0.0	0.2	0.3	0.5	0.7	0.9	1.2
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	-2.0	-5.4	-7.9	-9.9	-11.6	-13.0	-14.2	-15.4	-17.1	-18.9	-20.6
Price Level.....(pd)	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-0.9	-1.0	-1.2
Short-Term Rate..(d)	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.6	-0.7	-0.8	-0.9	-1.0
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Current Acct....(d).	0.3	-1.7	-4.1	-6.6	-9.3	-12.3	-15.5	-19.1	-23.3	-28.0	-33.1
Govt.Deficit....(d).	0.8	0.5	0.3	0.5	1.1	2.1	3.4	5.1	6.7	8.5	10.4
ROW SECTOR											
Real GNP.....(pd)	0.2	0.4	0.3	0.3	0.2	0.1	0.1	0.0	0.0	-0.0	-0.0
--Consumption...(pd)	0.3	0.4	0.3	0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.6
--Investment....(pd)	0.5	1.3	1.8	2.1	2.3	2.5	2.7	3.0	3.2	3.4	3.6
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	0.2	0.7	0.9	1.1	1.2	1.3	1.3	1.4	1.5	1.7	1.9
Price Level.....(pd)	0.1	0.2	0.4	0.5	0.7	0.8	1.0	1.1	1.2	1.3	1.3
Short-Term Rate..(d)	-2.5	-1.8	-1.7	-1.6	-1.6	-1.5	-1.5	-1.4	-1.4	-1.4	-1.4
Long-Term Rate...(d)	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3
Current Acct....(d).	1.0	2.8	4.7	6.3	7.7	9.1	10.3	11.9	14.0	16.5	19.2
Govt.Deficit....(d).	20.7	19.0	20.7	22.1	23.5	25.2	27.1	29.7	32.0	34.4	37.0
Exchange Rates.....											
MINIMOD4.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4
FRB6.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4
NIC8.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4
FRB18.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4

SOURCE: Congressional Budget Office simulations described in text.

NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

TABLE A-4a. SIMULATED ECONOMIC EFFECTS OF A GRADUAL INCREASE IN THE REST-OF-WORLD MONETARY BASE BY 4 PERCENT (Difference in percentage of GNP from baseline levels, except for variables marked (pd), which are percentage differences from baseline, and marked (d), which are differences from baseline)

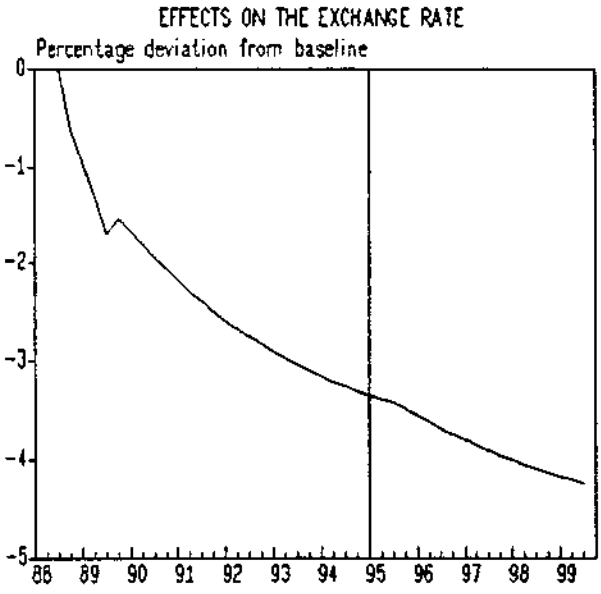
Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.0	0.0	0.0
--Consumption...(rd)	0.0	0.0	0.1	0.1	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0
--Investment....(rd)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2
--Government....(rd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.0	-0.0
--Net Exports...(rd)	-0.0	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.4	-0.4
Price Level.....(pd)	-0.1	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.8	-0.9	-1.0	-1.2
Short-Term Rate..(d)	-0.1	-0.2	-0.3	-0.4	-0.5	-0.6	-0.6	-0.7	-0.8	-0.9	-1.0
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1
Current Acct....(rd)	0.0	-0.0	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.3
Govt.Deficit....(rd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
ROW SECTOR											
Real GNP.....(pd)	0.2	0.4	0.3	0.3	0.2	0.1	0.1	0.0	0.0	-0.0	-0.0
--Consumption...(rd)	0.1	0.0	-0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3
--Investment....(rd)	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3
--Government....(rd)	-0.0	-0.1	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0
--Net Exports...(rd)	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Price Level.....(pd)	0.1	0.2	0.4	0.5	0.7	0.8	1.0	1.1	1.2	1.3	1.3
Short-Term Rate..(d)	-2.5	-1.8	-1.7	-1.6	-1.6	-1.5	-1.5	-1.4	-1.4	-1.4	-1.4
Long-Term Rate...(d)	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3
Current Acct....(rd)	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3
Govt.Deficit....(rd)	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Exchange Rates.....											
MINIMOD4.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4
FRB6.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4
NIC8.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4
FRB18.....(pd)	1.4	1.9	2.4	2.8	3.1	3.3	3.5	3.8	4.0	4.2	4.4

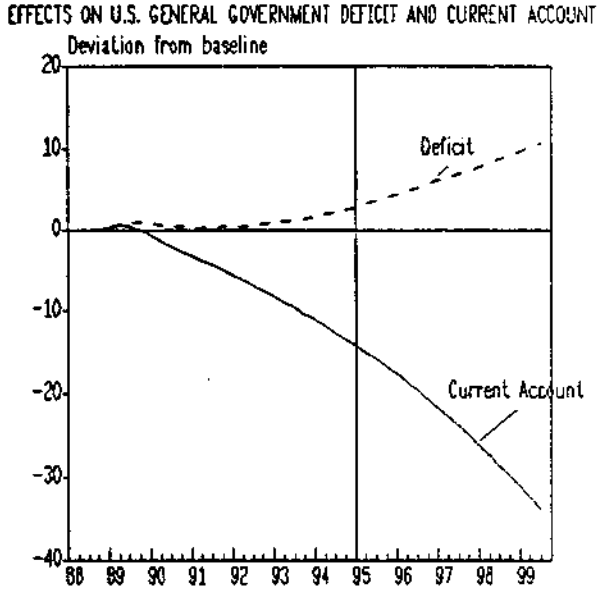
SOURCE: Congressional Budget Office simulations described in text.

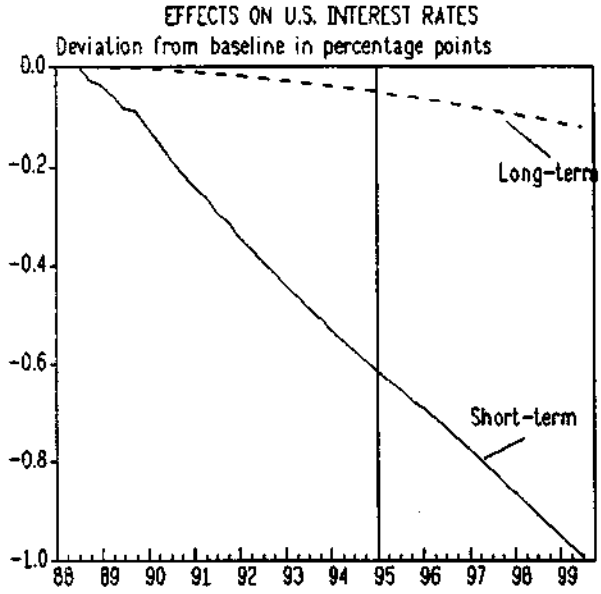
NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

FIGURE A-4. SIMULATED ECONOMIC EFFECTS OF A GRADUAL INCREASE IN THE REST-OF-WORLD MONETARY BASE BY 4 PERCENT







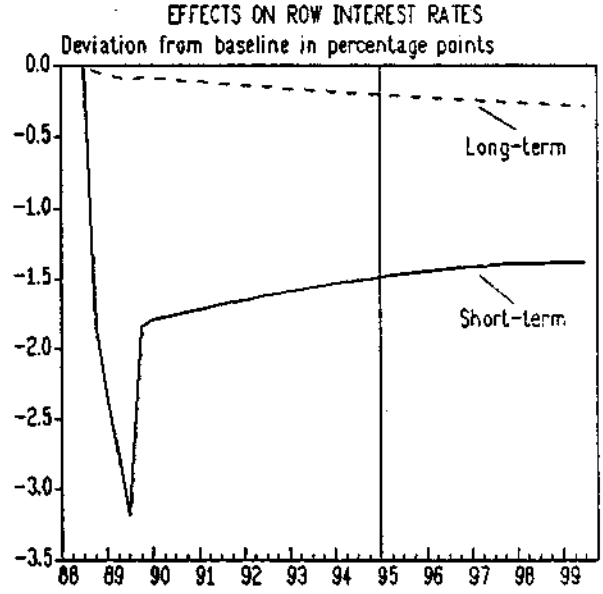
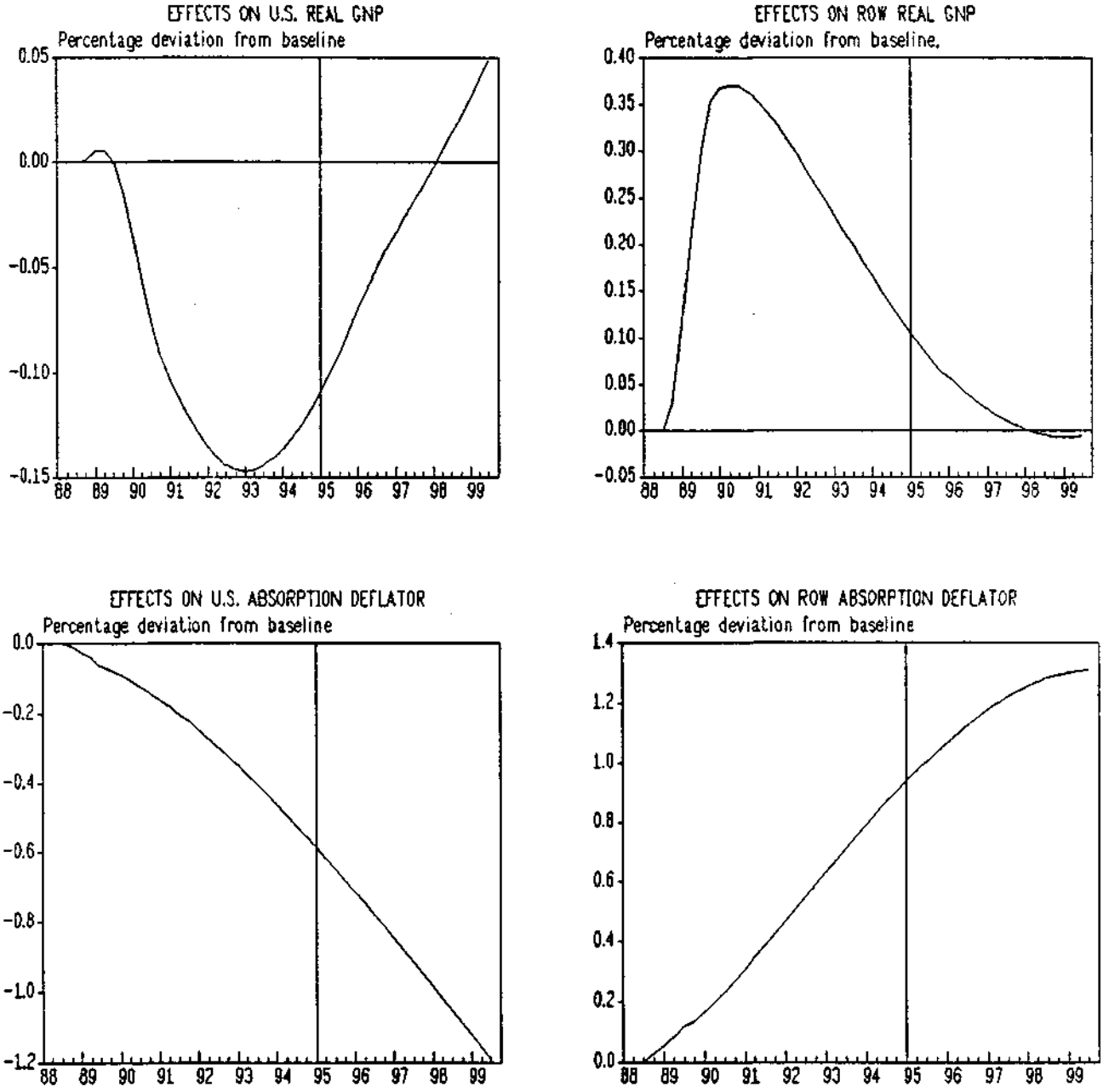


FIGURE A-4. CONTINUED



SOURCE: Congressional Budget Office simulations described in text.

TABLE A-5: SIMULATED ECONOMIC EFFECTS OF AUTONOMOUS DOLLAR DEPRECIATION BROUGHT ABOUT BY THE INTRODUCTION OF A RISK PREMIUM OF ONE PERCENTAGE POINT IN THE INTEREST PARITY CONDITION (Percentage differencE from baseline levels except for variables marked (d), which are differences from baseline)

Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.0
--Consumption...(pd)	-0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
--Investment....(pd)	0.0	0.1	0.1	0.0	-0.0	-0.1	-0.2	-0.3	-0.4	-0.6	-0.7
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	1.2	2.9	4.3	5.5	6.6	7.5	8.3	9.1	10.1	11.1	12.0
Price Level.....(pd)	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7
Short-Term Rate..(d)	0.0	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6
Long-Term Rate...(d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Current Acct....(d).	0.3	1.5	2.7	4.1	5.6	7.3	9.2	11.3	13.9	16.7	19.7
Govt.Deficit....(d).	-0.1	0.2	0.3	0.1	-0.2	-0.9	-1.7	-2.8	-3.9	-5.0	-6.2
ROW SECTOR											
Real GNP.....(pd)	-0.0	-0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
--Consumption...(pd)	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
--Investment....(pd)	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4
--Government....(pd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Net Exports...(d).	-0.1	-0.4	-0.5	-0.6	-0.7	-0.8	-0.8	-0.9	-1.0	-1.1	-1.1
Price Level.....(pd)	-0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
Short-Term Rate..(d)	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Current Acct....(d).	-0.7	-1.7	-2.6	-3.5	-4.3	-5.0	-5.7	-6.7	-7.9	-9.3	-10.8
Govt.Deficit....(d).	-0.1	-0.0	0.1	0.1	0.1	0.2	0.1	-0.2	-0.4	-0.6	-0.9
Exchange Rates.....											
MINIMOD4.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1
FRB6.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1
NIC8.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1
FRB18.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1

SOURCE: Congressional Budget Office simulations described in text.

NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

TABLE A-5a: SIMULATED ECONOMIC EFFECTS OF AUTONOMOUS DOLLAR DEPRECIATION BROUGHT ABOUT BY INTRODUCTION OF RISK PREMIUM OF 1 PERCENTAGE POINT IN INTEREST PARITY CONDITION (Difference in percentage of GNP from baseline levels, except for variables marked (pd), which are percentage differences from baseline, and marked (d), which are differences from baseline)

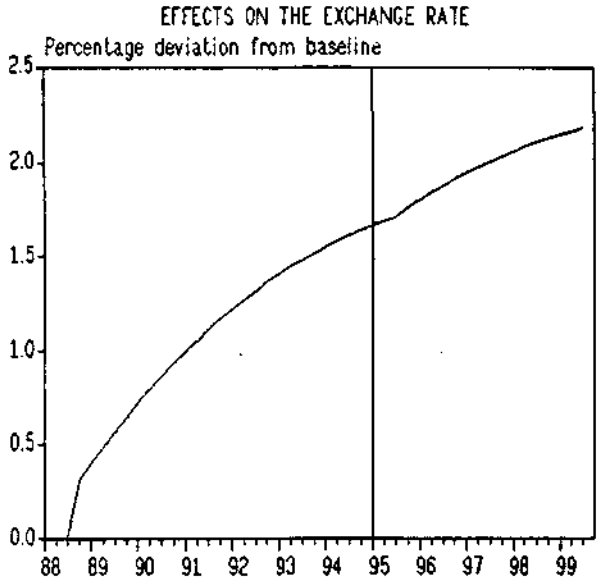
Variable	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
U.S. SECTOR.....											
Real GNP.....(pd)	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	-0.0
--Consumption...(rd)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.0	0.0	0.0
--Investment....(rd)	-0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1
--Government....(rd)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.0
--Net Exports...(rd)	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
Price Level.....(pd)	0.0	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7
Short-Term Rate..(d)	0.0	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6
Long-Term Rate...(d)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Current Acct....(rd)	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Govt.Deficit....(rd)	-0.0	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1
ROW SECTOR											
Real GNP.....(pd)	-0.0	-0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
--Consumption...(rd)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
--Investment....(rd)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
--Government....(rd)	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
--Net Exports...(rd)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1	-0.1	-0.1
Price Level.....(pd)	-0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.4
Short-Term Rate..(d)	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2
Long-Term Rate...(d)	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Current Acct....(rd)	-0.0	-0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
Govt.Deficit....(rd)	-0.0	-0.0	0.0	0.0	0.0	0.0	-0.0	-0.0	-0.0	-0.0	-0.0
Exchange Rates.....											
MINIMOD4.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1
FRB6.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1
NIC8.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1
FRB18.....(pd)	-0.5	-0.8	-1.1	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-2.1	-2.1

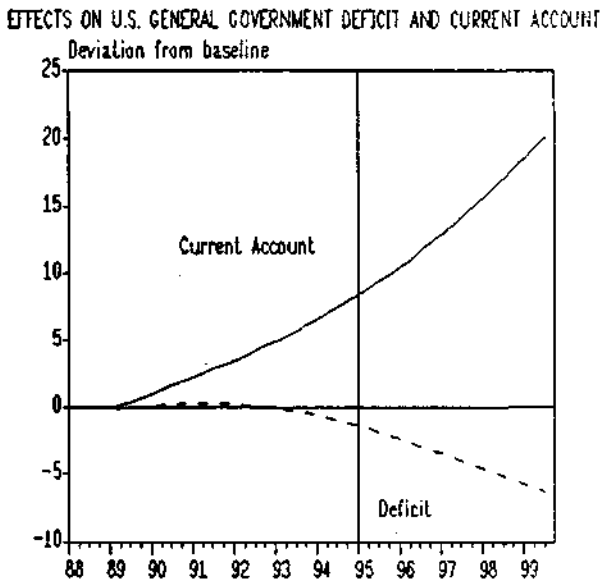
SOURCE: Congressional Budget Office simulations described in text.

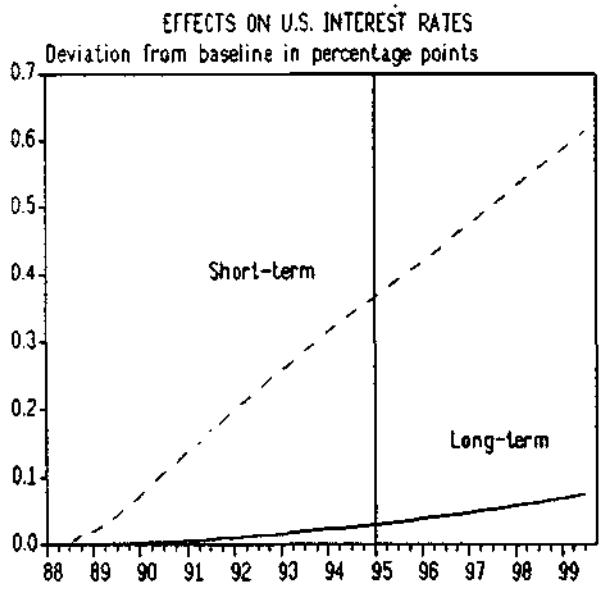
NOTE: Country Disaggregation:

MINIMOD4 = Canada, Germany, Japan, U.K.
FRB6 = Belgium, Denmark, France, Italy, Sweden, Switzerland
NIC8 = Brazil, Hong Kong, Korea, Mexico, Taiwan, Singapore, Malaysia, The Philippines

FIGURE A-5. SIMULATED ECONOMIC EFFECTS OF AUTONOMOUS DOLLAR DEPRECIATION BROUGHT ABOUT BY THE INTRODUCTION OF A RISK PREMIUM OF ONE PERCENTAGE POINT IN THE INTEREST PARITY CONDITION







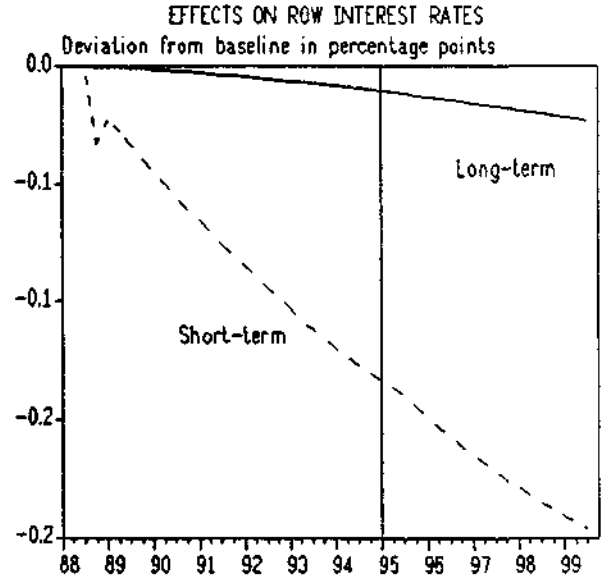
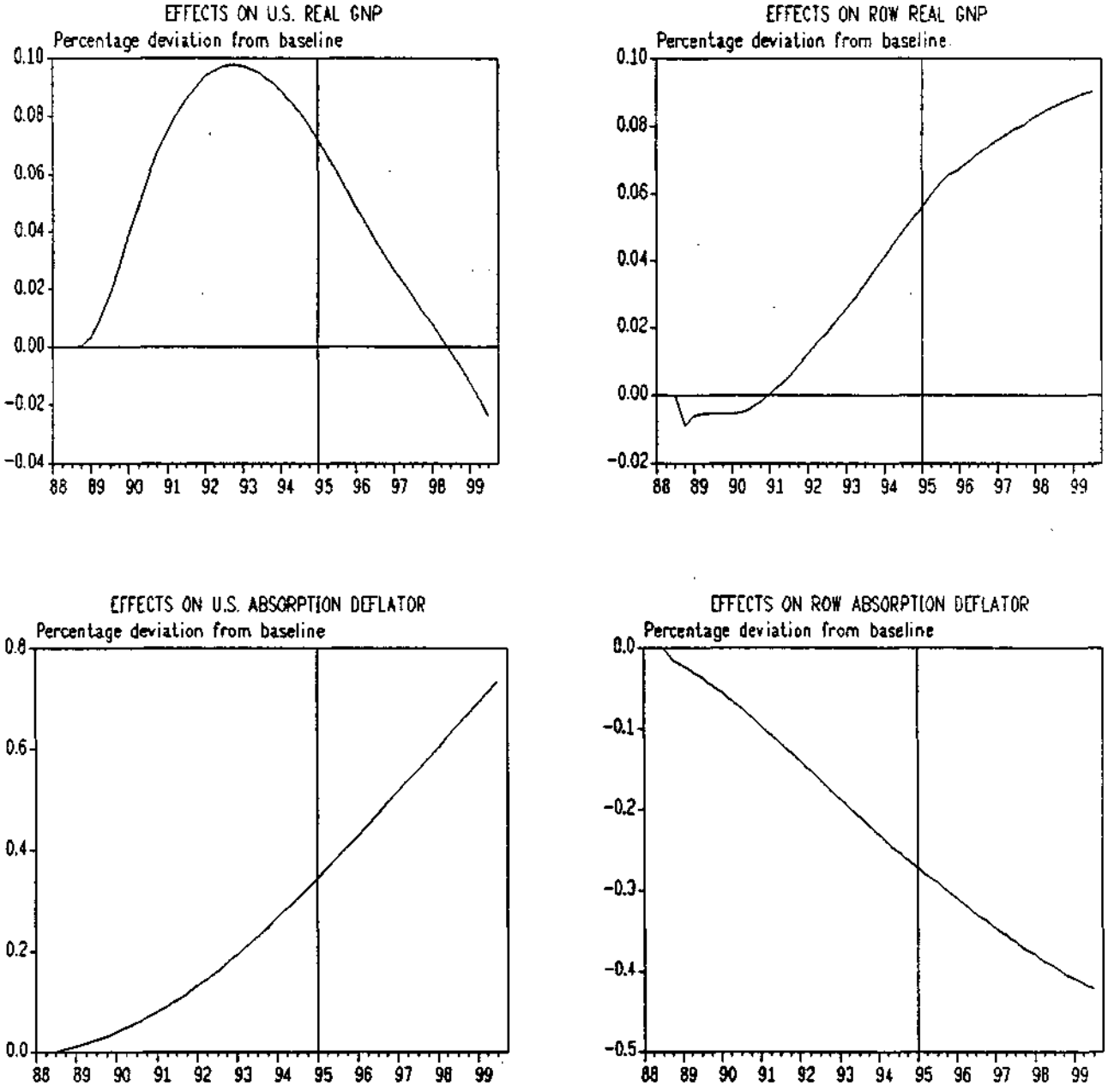


FIGURE A-5. CONTINUED



SOURCE: Congressional Budget Office simulations described in text.

APPENDIX B

MINIMOD EQUATIONS AND VARIABLES

- Equation summaries are supplied by square brackets below the coded equation where applicable.

- Variables denoted with the term "lev" or suffixed "ex" are lever variables for linking to appropriate SLUSIT current account model variables. Variables suffixed "damp" are equation damping factors.

- The computer coding notation "(??)" represents equation normalization.

1. DELRPBPI--PARTIAL EFFECT OF INFLATION EXPECTATIONS ON ROW INFLATION

   delrpbpi

   = 0.241165*((1+rpie)**0.25-1)+(1-0.241165)*delrpbpi.1+res43

2. DELUPBPI--PARTIAL EFFECT OF INFLATION EXPECTATION ON U.S. INFLATION

   delupbpi

   = 0.17689*((1+upie)**0.25-1)+(-0.10243)*((1+upie.1)**0.25-1)+1.4634* delupbpi.1+(-0.53786)*delupbpi.2+res14

3. E--EXCHANGE RATE ($ PER FOREIGN CURRENCY)

   e

   = ee/((1+epsilone-res59)**0.25)

4. EE--EXPECTED VALUE OF E NEXT PERIOD

   ee

   = 0.3*e+(1-0.3)*ee.1+res53

5. EPSILON--RATE OF CHANGE OF THE EXCHANGE RATE, AT ANNUAL RATES

   epsilon

   = (e/e.1)**4-1

6. EPSILONE--EXPECTED RATE OF CHANGE OF E AT ANNUAL RATES

epsilone

= (1+urs/100-res27-risk)/(1+rrs/100)-1

7. F--NET CLAIMS OF U.S. ON ROW (ASSUMED DENOMINATED IN U.S. $)

f-f.1

= (1-flev)*(ursq*f.1+(upgnp*ux-rpgnp*ui*e)/4+res26)+flev*(niip-niip.1+res26a)

(??)+F.1

8. RA--ROW REAL ABSORPTION

ra

= rc+4*(rk-rk.1)+rdelta*rk.1+rg+res30

9. RB--ROW NOMINAL STOCK OF GOVERNMENT DEBT

rb-rb.1+(rmy-rmy.1)

= ((rp*rg-rtax)/4+rrsq*rb.1+res39)

(??)-(RMY-RMY.1)+RB.1

10. RC--ROW REAL CONSUMPTION EXPENDITURE

rc

= (-ralpha)*rg+0.302/(1-0.56857)*rcby+(0.00634+0.022152)/(1-0.24771-0.101305)*rcbw+res34

[rc = 0.6997*rcby + 0.0437675*rcbw + res34]

11. RCBW--PARTIAL EFFECT OF ROW WEALTH ON CONSUMPTION

rcbw

=
0.00634/((0.00634+0.022152)/(1-0.24771-0.101305))*rw+0.022152/((0.00634+
0.022152)/(1-0.24771-0.101305))*rw.1+0.24771*rcbw.1+0.101305*rcbw.
2+res33

[rcbw = 0.1448563*rw + 0.506129*rw.1 + 0.24471*rcbw.1 + 0.101305*rcbw.2
+ res33]

12. RCBY--PARTIAL EFFECT OF DISPOSABLE INCOME ON ROW CONSUMPTION

rcby

= (1-0.56857)*ryd+0.56857*rcby.1+res32

13. RCU--RATE OF CAPACITY UTILIZATION IN ROW

rcu

= 100*rgdp/rycap+res49

14. RCURBAL--ROW CURRENT ACCOUNT BALANCE

rcurbal

= (-4)*(f-f.1)/e

15. RGDEF--ROW GENERAL GOVERNMENT DEFICIT

rgdef

= 4*((rb+rmy)-(rb.1+rmy.1))

16. RGDP--ROW REAL GROSS DOMESTIC PRODUCT

rgdp

= ra+(ui-ux)/tradscal+res31

17. RGE--TOTAL ROW GENERAL GOVERNMENT EXPENDITURES

rge

= rp*rg+rrsq*rb.1

18. RGNP--ROW REAL GROSS NATIONAL PRODUCT

rgnp

= rgdp-urs.1/100*f.1/e/tradscal/rpgnp+res58

19. RINV--ROW REAL INVESTMENT FLOWS

rinv

= 4*(rk-rk.1)+rdelta*rk.1+res381

20. RK--ROW REAL PHYSICAL CAPITAL STOCK

rk-rk.1

=
(0.0023*(.3*0.383*rgdp/rucstcap)+0.00534*(.3*0.383*rgdp.1/rucstcap.1)+0.0
0252*
(.3*0.383*rgdp.4/rucstcap.4)+0.6545*rk.1+(-0.66217)*rk.2+(-0.00252)
*rk.5+
0.00579*rk.1+res38)

[rk-rk.1 = 0.0002643* rgdp/rucstcap + 0.0006136* rgdp.1/rucstcap.1 +
0.0002895* rgdp.4/rucstcap.4 + 0.6545*rk.1 + (-0.66217)*rk.2 +
(-0.00252)*rk.5 + res38]

(??+RK.1)

21. RMONE--ROW MONEY SUPPLY (M1)

rmone

= rmult*rmy+res50

22. RP--ROW ABSORPTION DEFLATOR

rp

= (rpgnp*(rgnp-ui/tradscal)+ux/tradscal*upgnp/e+urs.1/100*f.1/e/tradscal-res45)/ra

23. RPGNP--ROW GNP DEFLATOR

rpgnp

= (rpgnpper+1)*rpgnp.1

rpgnpper

= 0.052141*log(rcu)-0.03061*log(rcu.1)+delrpbpi+res44

24. RPI--RATE OF CHANGE IN ROW ABSORPTION DEFLATOR, AT ANNUAL RATES

rpi

= (rp/rp.1)**4-1

25. RPIE--EXPECTED RATE OF CHANGE OF ABSORPTION PRICE IN ROW NEXT PERIOD

rpie

= 0.3*rpi+(1-0.3)*rpie.1+res52

26. RRL--ROW LONG-TERM BOND RATE

rrl

= rrle*(1+rrs/100)/(1+rrle/100)**0.25+res46

27. RRLE--EXPECTED ROW LONG-TERM BOND RATE NEXT PERIOD

rrle

= 0.2*rrl+(1-0.2)*rrle.1+res55

28. RRLR--ROW REAL EX POST LONG-TERM INTEREST RATE

rrlr

= (1+rrl.1/100)/(1+rpi)-1

29. RRS--ROW SHORT-TERM BOND RATE

rrs*((-0.518863)*0.01)

=
-0.22*log(rgnp)+(1-(1-rrsdamp)*0.72497)*log(rmone/rp)+(-0.72497*rrsdamp)*
log(rmone.1/rp.1)-res47

(??)/((-0.518863)*0.01)

30. RRSQ--ROW QUARTERLY SHORT-TERM INTEREST RATE

rrsq

= (1+rrs.1/100)**0.25-1

31. RRSR--ROW REAL EX POST SHORT-TERM INTEREST RATE

rrsr

= (1+rrs.1/100)/(1+rpi)-1

32. RT1--ROW TAX PARAMETER

rt1

= rt1bar+0.1*dum*(rb.1/rpgnp.1/rgnp.1-rbratio)+res61

33. RTAX--NOMINAL ROW TAX RECEIPTS

rtax

=0.332668*(rpgnp*rgdp-rdelta*rk.1*rp+rrs.1/100*rb.1-((1+urs.1/100)/(1+
epsilon)-1)*(f.1/e/tradscal)-rlambdat*rpi*((1+rrsr)*rb.1-(1+urs.1/100
)/(1+epsilon)/(1+rpi)*f.1/tradscal/e))+0.168227*rtax.1+res40

34. RUCSTCAP--ROW USER COST OF CAPITAL

rucstcap

= ((1+rrl/100)/(1+rpibar)-1+rdelta)/(1-rmrt)

35. RW--ROW REAL PRIVATE SECTOR NET WEALTH

rw

= rlambdam*(rmy/rp)+rlambdab*(rb/rp)-f/e/tradscal/rp+rk+res35

36. RYCAP--ROW CAPACITY OUTPUT

log(rycap)

= rscale+log(1+0.00579)*t*(1-0.383)+log(rk.1)*0.383

exp(??)

37. RYD--ROW REAL DISPOSABLE INCOME

ryd

=

rgdp*rpgnp/rp-rdelta*rk.1-rtax/rp+rydamp*(rrsr*(rb.1/rp))-((1+urs.1/100)/(1+
epsilon)/(1+rpi)-1)*(f.1/e/tradscal)/rp-(1-rlambdab)*(rb-rb.1)/rp+res36

38. UA--U.S. REAL ABSORPTION

ua

= uc+4*(uk-uk.1)+udelta*uk.1+ug+res1

39. UB--U.S. NOMINAL STOCK OF GOVERNMENT DEBT

ub-ub.1+(um-um.1)

= (ursq*ub.1+(up*ug-utax+ugexog)/4+res10)

(??)+UB.1-(UM-UM.1)

40. UC--U.S. REAL CONSUMPTION EXPENDITURE

uc

= (-0)*ug+(0.252096+0.021982)/(1-0.594668)*ucby+ucdamp*(-3.05811+(-0.456031))/(1-0.42672)*ucbr*ugnp/1361.01+0.043768*uw.1+res5

[uc = 0.6761815*ucby + ucdamp*(-6.1298842)*ucbr*ugnp/1361.01 + 0.043768*uw.1 +res5]

41. UCBR--PARTIAL EFFECT OF REAL INTEREST RATE ON U.S. CONSUMPTION

ucbr

= (-3.05811)*(1-0.42672)/(-3.05811+(-0.45603))*100*((1+url.2/100)/(1+upibar.2)-1)-0.456031*(1-0.42672)/(-3.05811+(-0.45603))*100*((1+url.3/100)
/(1+upibar.3)-1)+0.42672*ucbr.1+res4

[ucbr = 0.4988854*100*{(1+url.2/100)/(1+upibar.2) -1} +
0.0743947*100*{(1+url.3/100)/(1+upibar.3) -1} + 0.42672*ucbr.1
+ res4]

42. UCBY--PARTIAL EFFECT OF DISPOSABLE INCOME OF U.S. CONSUMPTION

ucby

=
(1-0.594668)/(0.252096+0.021982)*(.252096*uyd+.021982*uyd.1)+0.594668*ucby.1+res3

[ucby = 1.4788929 * (0.252096*uyd + 0.021982*uyd.1) + 0.594668*ucby.1 + res3]

43. UCU--RATE OF U.S. CAPACITY UTILIZATION

ucu

= 100*ugdp/uycap+res18

44. UCURBAL--U.S. CURRENT ACCOUNT BALANCE

ucurbal

= 4*(f-f.1)

45. UGDEF--U.S. GENERAL GOVERNMENT DEFICIT

ugdef

= 4*((ub+um)-(ub.1+um.1))

46. UGDP--U.S. REAL GROSS DOMESTIC PRODUCT

ugdp

= ua+ux-ui+res2

47. UGE--TOTAL U.S. GENERAL GOVERNMENT EXPENDITURES

uge

= up*ug+ursq*ub.1+ugexog

48. UGNP--U.S. REAL GROSS NATIONAL PRODUCT

ugnp

= ugdp+urs.1/100*f.1/upgnp+res57

49. UI--VOLUME OF U.S. IMPORTS OF GOODS AND NON-FACTOR SERVICES

log(ui)

=(1.37984+(-0.722509))/(1-0.711355)*uibact+((-0.070178)+(-0.016281)+(-0.099974))/(1-0.761522-(-0.087122))*uibe+res24

[log(ui) = 2.2772991*uibact + (-0.5725829)*uibe +res24]

(1-uilev)*exp(??)+uilev*uiex*(emgnia82+emso82)/(emgnia82ex+emso82ex)

50. UIBACT--PARTIAL EFFECT OF U.S. ABSORPTION ON U.S. IMPORTS

uibact

=
(1-0.711355)/(1.37984+(-0.722509))*(1.37984*log(ua)+(-0.722509)*log(ua.1))
+0.711355*uibact.1+res22

[uibact = 0.4391167 * {1.37984*log(ua)+(-0.722509)*log(ua.1)} + 0.711355*uibact.1 + res22]

51. UIBE--PARTIAL EFFECT OF REAL EXCHANGE RATE ON U.S. IMPORTS

uibe

= (-0.070178)/(((-0.070178)+(-0.016281)+(-0.099974))/(1-0.761522-(-0.087122)))*log(e*rpgnp/upgnp)+(-0.016281)/(((-0.070178)+(-0.016281)+(-0.099974))/(1-0.761522-(-0.087122)))*log(e.1*rpgnp.1/upgnp.1)+(-0.099974)/(((-0.070178)+(-0.016281)+(-0.099974))/(1-0.761522-(-0.087122)))*log(e.2*rpgnp.2/upgnp.2)+0.761522*uibe.1+(-0.087122)*uibe.3+res23

[uibe = 0.1225639 * log(e* rpgnp/upgnp) +
0.0284343 * log(e.1* rpgnp.1/upgnp.1) +
0.1746018 * log(e.2* rpgnp.2/upgnp.2) + 0.761522*uibe.1 + (-0.087122)*uibe.3 + res23]

52. UINV--U.S. REAL INVESTMENT FLOWS

uinv

= 4*(uk-uk.1)+udelta*uk.1+res91

53. UK--STOCK OF U.S. REAL PHYSICAL CAPITAL

uk-uk.1

=
(0.27905*(uk.1-uk.2)+0.02937*(ukdamp*0.326/(uucstcap**0.8)*ugdp-uk.1)+
0.00579*uk.1+res9)

(??+UK.1)

54. UMONE--U.S. MONEY SUPPLY (M1)

umone

= umult*um+res15

55. UP--U.S. ABSORPTION DEFLATOR

up

= (upgnp*(ugnp-ux)+ui*(jerpgnp*pm)-urs.1/100*f.1-res12)/ua

56. UPGNP--U.S. GNP DEFLATOR

upgnp

= (upgnpper+1)*upgnp.1

upgnpper

=
0.02248*log(ucu)+0.048106*log(ucu.1)+(-0.032238)*log(ucu.2)+delupbpi+r
es16

57. UPI--RATE OF CHANGE OF U.S. ABSORPTION DEFLATOR, AT ANNUAL RATES

upi

= (up/up.1)**4-1

58. UPIE--EXPECTED RATE OF CHANGE OF THE U.S. ABSORPTION DEFLATOR NEXT PERIOD

upie

= 0.3*upi+(1-0.3)*upie.1+res51

59. URL--U.S. LONG-TERM BOND RATE

url

= urle*(1+urs/100)/(1+urle/100)**0.25+res28

60. URLE--EXPECTED U.S. LONG-TERM BOND RATE NEXT PERIOD

urle

= 0.2*url+(1-0.2)*urle.1+res54

61. URLR--U.S. REAL EX POST LONG-TERM INTEREST RATE

urlr

= (1+url.1/100)/(1+upi)-1

62. URS--U.S. SHORT-TERM BOND RATE

urs*((-0.339518)*0.01)

= (-0.259104*log(ugnp)-0.099481*log(ugnp.1)+0.130362*0.01*urs.1+(1-(1-ursdamp)*0.616057)*log(umone/up)+(-0.616057*ursdamp)*log(umone.1/up.1)-
res29)

(??)/((-0.339518)*0.01)

63. URSQ--U.S. QUARTERLY SHORT-TERM INTEREST RATE

ursq

= (1+urs.1/100)**0.25-1

64. URSR--U.S. REAL EX POST SHORT-TERM INTEREST RATE

ursr

= (1+urs.1/100)/(1+upi)-1

65. UT1--A U.S. TAX PARAMETER

ut1

= ut1bar+0.1*dum*(ub.1/upgnp.1/ugnp.1-ubratio)+res60

66. UT2--A U.S. TAX PARAMETER

ut2

= ut1/(ut1bar/ut2bar)

67. UTAX--U.S. NOMINAL TAX RECEIPTS

utax

= utax.1+0.35*((upgnp*ugdp-udelta*uk.1*up+urs.1/100*(ub.1+f.1))-(upgnp.1*ugdp.1-
udelta*uk.2*up.1+urs.2/100*(ub.2+f.2)))-.08*(upgnp-upgnp.1)*ugdp.1+res11

68. UUCSTCAP--U.S. USER COST OF CAPITAL

uucstcap

= ((1+url/100)/(1+upibar)-1+udelta)/(1-umrt)

69. UW--U.S. REAL PRIVATE SECTOR NET WEALTH

uw

= ulambdam*(um/up)+ulambdab*(ub/up)+f/up+uk+res6

70. UX--VOLUME OF U.S. EXPORTS OF GOODS AND NON-FACTOR SERVICES

log (ux)

=
0.78992/(1-(-0.03281))*uxbact+(0.023369+0.106272)/(1-0.882563)*uxbe+res21

[log(ux) = 0.7648261*uxbact + 1.1039195*uxbe + res21]

(1-uxlev)*exp(??)+uxlev*uxex*(exgnia82+exso82)/(exgnia82ex+exso82ex)

71. UXBACT--PARTIAL EFFECT OF ROW ABSORPTION ON U.S. EXPORTS

uxbact

= (1-(-0.03281))*log(ra)+(-0.03281)*uxbact.1+res19

72. UXBE--PARTIAL EFFECT OF REAL EXCHANGE RATE ON U.S. EXPORTS

uxbe

=
(1-0.882563)*0.023369/(0.023369+0.106272)*log(e*rpgnp/upgnp)+0.882563*
uxbe.1+(1-0.882563)*0.106272/(0.023369+0.106272)*log(e.1*rpgnp.1/
upgnp.1)
+res20

[uxbe = 0.0211691 * log(e* rpgnp/upgnp) + 0.882563*uxbe.1 +
0.0962679 * log(e.1* rpgnp.1/upgnp.1) + res20]

73. UYCAP--U.S. CAPACITY OUTPUT

log(uycap)

= uscale+log(1+0.00579)*t*(1-0.326)+log(uk.1)*0.326

exp(??)

74. UYD--U.S. REAL DISPOSABLE INCOME

uyd

=

ugdp*upgnp/up-udelta*uk.1-utax/up+ursr*(ub.1+f.1)/up-(1-ulambdab)*(ub-ub.1)/up+res7

MINIMOD Variables

Endogenous Variables

DELRPBPI	Partial effect of inflation expectations on ROW inflation
DELUPBPI	Partial effect of inflation expectations on US inflation
E	Exchange rate ($ per foreign currency)
EE	Expected value of E next period
EMGNI82	NIPA merchandise imports, 1982$ (SLUSIT)
EMSO82	NIPA other service imports, 1982$ (SLUSIT)
EPSILONE	Expected rate of change of E at annual rates
EXGNIA82	NIPA merchandise exports, 1982$ (SLUSIT)
EXSO82	NIPA other service exports, 1982$ (SLUSIT)
F	Net claims of US on ROW (assumed denominated in US $)
NIIP	Net claims of US on ROW (SLUSIT)
RA	ROW real absorption
RB	ROW nominal stock of government debt
RC	ROW real consumption expenditure
RCBW	Partial effect of ROW wealth on consumption
RCBY	Partial effect of disposable income on ROW consumption
RCU	Rate of capacity utilization in ROW
RGDP	ROW real gross domestic product
RGNP	ROW real gross national product
RK	ROW real physical capital stock
RMONE	ROW money supply (M1)
RP	ROW absorption deflator
RPGNP	ROW GNP deflator
RPGNPPER*	Rate of change in ROW GNP deflator
RPIE	Expected rate of change of absorption price in ROW next period
RRL	ROW long-term bond rate
RRLE	Expected ROW long-term bond rate next period
RRLQ*	Quarterly long term US bond rate
RRS	ROW short-term bond rate
RTAX	Nominal ROW tax receipts
RT1	ROW tax parameter
RW	ROW real private sector net wealth
RYCAP	ROW capacity output
RYD	ROW real disposable income
UA	US real absorption
UB	US nominal stock of government debt
UC	US real consumption expenditure
UCBR	Partial effect of real interest rate on US consumption
UCBY	Partial effect of disposable income on US consumption
UCU	Rate of US capacity utilization
UGDP	US real gross domestic product
UGNP	US real gross national product
UI	Volume of US imports of goods and non-factor services
UIBACT	Partial effect of US absorption on US imports
UIBE	Partial effect of real exchange rate on US imports
UK	Stock of US real physical capital
UMONE	US money supply (M1)

UP	US absorption deflator
UPGNP	US GNP deflator
UPGNPPER*	Rate of change in the US GNP deflator
UPIE	Expected rate of change of the US absorption deflator next period
URL	US long-term bond rate
URLE	Expected US long-term bond rate next period
URLQ*	Quarterly long term ROW bond rate
URS	US short-term bond rate
UTAX	US nominal tax receipts
UT1	A US tax parameter
UT2	A US tax parameter
UW	US real private sector net wealth
UX	Volume of US exports of goods and non-factor services
UXBACT	Partial effect of ROW absorption on US exports
UXBE	Partial effect of real exchange rate on US exports
UYCAP	US capacity output
UYD	US real disposable income

Definitions

EPSILON	Rate of change of the exchange rate, at annual rates
RCURBAL	ROW current account balance
RGDEF	ROW general government deficit
RGE	Total ROW general government expenditures
RINV	ROW capital investment
RPI	Rate of change in ROW absorption
RRLR	ROW real ex post long-term interest rate
RRSQ	ROW quarterly short-term interest rate
RRSR	ROW real ex post short-term interest rate
RUCSTCAP	ROW user cost of capital
UCURBAL	US current account balance
UGDEF	US general government deficit
UGE	Total US general government expenditures
UINV	US capital investment
UPI	Rate of change of US absorption deflator, at annual rates
URLR	US real ex post long-term interest rate
URSQ	US quarterly short-term interest rate
URSR	US real ex post short-term interest rate
UUCSTCAP	US user cost of capital

Exogenous Variables

DUM	Dummy variable equals 1 from 91:1 onwards
RBRATIO	Equilibrium ratio of ROW bond stock to GNP
RDELTA	Depreciation rate for ROW physical capital
RISK	Premium or discount in interest rate parity condition
RG	ROW government expenditure on goods and services
RMY	ROW monetary base
RMRT	ROW marginal tax rate (net of transfers, corporate, and personal)
RMULT	ROW money multiplier
RPIBAR	ROW long-run inflation expectations

RRLQDAMP*	Damping factor for highly nonlinear RRLQ equation
RSCALE	Scale factor in ROW production function
RT1BAR	'Normal' value of RT1
RT2	A ROW tax parameter
T	Time trend
TRADSCAL	Multiplier that reflects ratio of total US trade to that with MCM countries (Japan, Germany, UK, Canada)
UBRATIO	Equilibrium ratio of US bond stock to GNP
UDELTA	Depreciation rate for US physical capital
UG	US real government expenditure on goods and services
UGEXOG	US government transfers to foreigners and net subsidies to government enterprises
UM	US monetary base
UMRT	US marginal tax rate (net of transfers, corporate and personal)
UMULT	US money multiplier
UPIBAR	US long-run inflation expectations
URLQDAMP*	Damping factor for highly nonlinear URLQ equation
USCALE	Scale factor in US production function
UT1BAR	'Normal' value of UT1
UT2BAR	'Normal' value of UT2

Parameters

RALPHA*	Proportion of change in ROW government expenditure that is directly offset by change in consumption expenditure
RLAMBDAB	Proportion of ROW government debt included in ROW private net wealth
RLAMBDAM	Proportion of ROW monetary base included in ROW private net wealth
RLAMBDAT	Degree of ROW tax indexation of inflation premium in interest income
UALPHA*	Proportion of change in US government expenditure that is directly offset by changes in consumption expenditure
ULAMBDAB	Proportion of US government debt included in US private net wealth
ULAMBDAM	Proportion of US monetary base included in US private net wealth
ULAMBDAT	Degree of US tax indexation of inflation premium in interest income

* Indicates variables that do not exist in original IMF data bank (MININEW).